THE STATE OF WYOMING

ED HERSCHLER
GOVERNOR

Wyoming Department of Agriculture

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MEMORANDUM

DATE: August 2, 1976

TO: Mr. Anthony G. Weilang,
Bureau of Land Management

FROM: George F. Hittle, Weed & Pest Coordinator

SUBJECT: Request for emergency program to control designated noxious weeds in Northeastern Wyoming.

A. Objective:

1. (a) Project Name: Clear Creek program area and Belle Fourche program area, (Johnson, Sheridan, Campbell, Crook and Weston Counties in Wyoming.)

(b) Specific target pest: Canada Thistle, Leafy spurge, Musk Thistle, Yellow Toadflax and Russian Knapweed.

(c) Purpose: Is to protect natural resource lands from becoming heavily infested with noxious weeds, protect valuable cropland from becoming reinfested by Federal lands, help restore natural vegetation. The project will be completed in cooperation with private and state programs being conducted in the area.

B. 1. Pesticide

2. (a) Common name: Tordon 22K

(b) Formulation: 4-Amino-3,5,6 Trichloropicolinic Acid

(c) Lb/gal: 2# per gal. of active ingredients.

(d) Registration: E.P.A. Registration no. 464-323-AA; Tordon 22K is registered with a state label for use in rangeland, permanent grass pastures in the state of Wyoming. No. 464-323-0168-76.

3. (a) Form applied: Solution

(b) Use Strength: ½ to 1 gal. Tordon 22K in 5 to 150 gal. of water: Amount of water depends on method of application.

(c) Diluent: Water

4. lbs Active/acre: 1# to 2#/acre depending on which noxious weed species is being treated. This represents a concentration of 0.295 to 0.58 ppm/ac of active ingredient of picloram acid.

5. (a) Method: Ground units and hand sprayers.

6. (a) Acres:

Campbell County -	113½ acres
Crook County	46½ acres
Johnson County	124 acres
Sheridan County	24 3/4 acres
Weston County	43 acres
TOTAL	351.75 Acres

Acres is located on scattered federal lands within 2,525,970.00 acre program area.

(b) Number of application: 1 application with following programs for next year.

(c) Number of sites - Several

(d) Specific description of sites: Land is within Clear Creek and Belle Fourche program area.

7. (a) Month's of year - April to October

(b) State: Wyoming

D. Sensitive Areas

8. (a) Areas to be avoided: Lakes and cropland.

E. Remark

9. (a) Precautions to be taken: Chemicals to be applied in full compliance with the label. No spraying when wind velocity exceeds 7 mph.

(b) Project will be under the supervision of weed & pest control supervisor in the counties listed under P.L. 90-583 in cooperative agreements with Wyoming Department of Agriculture.

(c) State and local coordination: Wyoming Department of Agriculture has entered into contracts with B.L.M. under P.L. 90-853.

(d) Other pesticides being applied to same site: None

(e) Monitoring: of the stream flow for chemical residue in the areas will be conducted in cooperation with U.S.G.S. under U.S.G.S.-W.D.A. Pesticide - Herbicide Program.

(f) Other - Environmental Analysis Report has been completed.

cc: Larry J. Bourret, Commissioner of Agriculture
Walt Patch, Director, Plant Industry
Crook, Weston, Campbell, Sheridan and Johnson Counties Weed & Pest Control Districts.

GFH/kp/bm

THE STATE OF WYOMING

Ed Herschler
GOVERNOR

Wyoming Department of Agriculture

CHEYENNE, WYOMING 82002

ENVIRONMENTAL ANALYSIS REPORT

NAME OF PROPOSAL:

PILOT PROJECT FOR THE CONTAINMENT AND

ERADICATION OF LEAFY SPURGE IN THE OLD WEST REGION

AREAS: Clear Creek Drainage in Sheridan, Johnson & Campbell Counties

Belle Fourche Drainage in Crook, Weston & Campbell Counties

Prepared by George J. Kittle Date _____
Weed & Pest Coordinator

Recommended by Lanny J. Bonnet Date Sept. 4, 1975
Commissioner of Agriculture

Recommended by _____ Date _____

Recommended by _____ Date _____

Approved by _____ Date _____

ENVIRONMENTAL ANALYSIS REPORT

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APPENDIX (Attachments, Snapshots and oblique photos)

(Instructions: The intensity of the analysis and size of report should be held commensurate with the proposal's potential to affect the associated environment. Except for highly significant elements, the report should refer to, not duplicate, detailed information otherwise readily available to reviewers. However, be sure to cover environmental effects historically important to the class of action even though not serious to the current proposal.)

ENVIRONMENTAL ANALYSIS REPORT

Containment and Eradication of Leafy Spurge in The Old West Region., as it concerns Wyoming.

Area 1: Clear Creek drainage in Sheridan, Johnson and Campbell County, Wyoming.

Area 2: Belle Fourche drainage in Crook, Weston and Campbell County, Wyoming.

Map of program area : Attachment A-1 and A-2.

I. Description

The purpose of this report (E.A.R.) is to evaluate the treating of approximately 17,209 acres of Leafy Spurge (Euphorbia esula) in The Old West Region (Area 1 & 2) using Tordon 22 and/or Tordon 212 at rate of 2 lbs. (Active ingredient per acre of Picloram Acid) on 15,710 acre of permanent grass pasture and rangeland, and 2-4-D and/or Banvel at rate of 2 lbs to 6#/AC plus clean cultivation on 1,499 acres of cultivated land.

The proposed program area is located on Clear Creek and Belle Fourche drainage in Sheridan, Johnson, Campbell, Weston and Crook counties of Wyoming and encompasses an area of approximately 1,526,752 acres. Approximately 17,209 acres would be treated within the program area, or approximately 1% of outlined area (Attachment A-1 and A-2)

Natural vegetation and precipitation zones in project area varies and is as follows.

Area 1: (1) Precipitation zone 20 inches plus mountains

Woodland Species: Lodgepole pine, Douglas fir, Alpine fir, aspen.

Grassland Species: Bluebunch wheatgrass, Columbia needlegrass, spike fescue, one-spike dothonia grass, big sagebrush, black sagebrush, snowberry and numerous forbs.

Elevation (10,000' - 7,500')

(6) Precipitation zone 15 to 19 inches foothills and mountains east.

Woodland Species: Alpine Fir, Douglas Fir, Lodgepole pine, ponderosa pine, aspen.

Grassland Species: Idaho fescue, Columbia needlegrass, blue-bunch wheatgrass, spike fescue, mountain brome, western wheatgrass, big sagebrush.

Elevation (7,500'-4,800')

(12) Precipitation zone 15 to 17 inches northern plains.

Woodland Species: Ponderosa pine, juniper, cottonwood.

Grassland Species: Western wheatgrass, green needlegrass, little bluestem, prairie sandreed grass, needleandthread grass, big sagebrush, low rabbitbrush, greasewood.

Elevation (4,000)

(13) Precipitation zone 10 to 14 inches northern plains.

Woodland Species: Cottonwood on low land sites.

Grassland Species: Western wheatgrass, blue grama grass, needleandthread grass, prairie sandreed grass, big sagebrush, greasewood.

Elevation (4,800'-3,500')

Area 2 (12) Precipitation zone 15 to 17 inches northern plains

Woodland Species: Ponderosa pine, juniper, cottonwood.

Grassland Species: Western wheatgrass, green needlegrass, little blue-stem, prairie sandreed grass, needleandthread grass, big sagebrush, low rabbitbrush, greasewood.

Elevation (4,200'-3,200)

(13) Precipitation zone 10 to 14 inches northern plains

Woodland Species: Cottonwood on low land sites.

Grassland Species: Western wheatgrass, blue grama grass, needleandthread grass, prairie sandreed grass, big sagebrush, greasewood.

Elevation (5,000'-4,200')

(14) Precipitation zone 15 to 19 inches Black Hills

Woodland Species: Ponderosa pine, burr oak.

Grassland Species: Western Wheatgrass, big bluestem grass, little bluestem grass, needleandthread, sideoats, grama grass, Kentucky bluegrass, chokecherry, snowberry, mountain mohogany and numerous forbs.

Elevation (4,200-3,668)

(15) Precipitation zone 20 to 24 inches Black Hills

Woodland Species: Douglas fir and Engelmann spruce.

Grassland Species: Timber oatgrass, Idaho fescue, green needlethread grass, Kentucky bluegrass.

Elevation (4,765-3,989)

(Also refer to attachment A-3) .

Mean annual air temperatures range from_____° to_____°., with extremes from ____° to _____°.

Soil types and capabilities: Refer to attached map A_4

Land status - Infestation of known Leafy Spurge acres only.

Private:	14,649	infested acres % :	85
Federal	1,010	infested acres % :	6
State	1,550	infested acres % :	9
Total	17,209	infested acres % :	100%

Wildlife in program area consists of elk, deer, antelope, sage grouse, pheasants, rabbits, small birds and mammals. It is questionable whether any elk range is located on actual treatment sites. No rare and endangered species of animals or plants exist on the proposed infested area.

II. Environmental Impacts.

Application treatment will be applied in four phases based on existing climatic condition, vegetative cover and topography.

Phase 1: Helicopter @ height of 25 feet

Phase 2: Ground unit @ height of 1½ feet

Phase 3: Hand sprayers @ of 1½ feet

Phase 4: Hand Spreaders @ height of 3½ feet

"When properly applied at recommended rates and techniques, Tordon and 2,4-D is not considered poisonous to man, domestic animals, fish or game." 1/ Drift of herbicides from the target area are not considered harmful to animal life, although it may be harmful to non-target plant life.

Toxicity of the chemicals recommended for treatment is shown in Attachment B. Fate and translocation of herbicides is shown in Attachment C_1 and C_2.

Precaution measures will be as outlined on labels: Attachment D_1, D_2 and D_3.

Invert emulsion will be added to minimize any drift.

1. Application will be limited to following periods.

   a. Helicopter: When wind velocity does not exceed 3 m.p.h.

   b. Ground units: When wind velocity does not exceed 5 m.p.h.

   c. Hand sprayers: When wind velocity does not exceed 7 m.p.h.

   d. Hand spreaders: When wind velocity does not exceed 7 m.p.h.

Application will be conducted when rain conditions are absent, and the air turbulence (thermal updrafts, etc.) are not so great as to seriously affect the

normal spray pattern.

Portable weather station will be set up in area of operation. Weather will be monitored on a daily basis, and also all available weather information will be utilized.

2. Aesthetics: Approximately 17,209 acres of Leafy Spurge will be contained and eradicated. Native grasses, forbs and shrubs will gradually replace the dead Leafy Spurge. Areas will convert and revert back to its natural ecology. Leafy Spurge which in unpalatable to all classes of domestic and game animals would be replaced by desirable natural species.

3. Outdoor Recreation: There are developed recreation sites within project area, however, there will be no adverse condition and outdoor recreation should not be affected. Devil's Tower National Park is located within area No. 2. Application within the park would be conducted with use of ground equipment, hand sprayers and hand spreaders. No adverse condition should prevail. Recreation area appearance will improve in direct proportion with the project.

4. Vegetative Resource: Will be most affected by this project. About 17,209 acres of primarily heavy Leafy Spurge infestation will be converted to native grasses, forgs and shrubs. Projects on adjacent private lands have remarkably improved the vegetation. Improved vegetation will provide more forage and ground cover for cattle and wildlife, such as deer, antelope and smaller birds and mammals. Soil stability, in addition to increased vegetation, will be improved by this project. Opportunities to employ multiple use concept will be increased.

5. Soil stabilitity will increase and soil erosion will decrease indirect (corrolation) relation to the project. Increased vegetation will provide excellent soil cover and better soil stability.

6. Watershed: The entire area within the watersheds will be affected as control of 17,209 acres of primarily heavy Leafy Spurge infestation will allow native vegetation to improve and increase. The increase of sod forming and bunch grasses will improve water infiltration and reduce runoff of water. Reduction of runoff will limit soil erosion and sedimentation within existing water courses, thus improving water quality.

Increased water infiltration will assist in improving vegetative composition and provide more water for meeting the plant water requirements of grasses, forbs and shrubs. This improvement within the total watershed will also allow more forage of native vegetation for livestock grazing and wildlife habitat while conserving the soil and water resources. Flowing water is a means of spread of weed seed.

Soil moisture studies have clearly shown that watersheds can be improved by controlling undesirable plant species. Special care will have to be taken and the program of aerial application monitored to eliminate contamination of streams with Tordon.

Illustrated in Attachment No. E.

The U.S.D.A., S.C.S. will provide a soil scientist for the project if required.

7. Natural Vegetative Cover: No injury is anticipated to natural vegetation.

8. Water: Clear Creek flows through area No. 1 and The Belle Fourche River flows through area No. 2. Runoff could occur only if heavy rains follow treatment.

9. Wilderness: There is a wilderness area on the upper end of area No. 1, however, it is anticipated that Leafy Spurge does not exist in this area. The area was included because it is the headwaters of Clear Creek. If infestations of Leafy Spurge are located, the size would be very small and could be spot-treated without damage to the environment.

10. Fish and Wild life no feed or cover loss result by removing Leafy Spurge from the area. It is felt that the impact of this project to all fish and wild life species will be minimum and will cause no adverse conditions. No rare and endangered species of animal, plant, or fish exist in the proposed infested ares. Monitoring of stream flow will be as outlined in II. 17 of this report. Fisheries Biologist from the Wyoming Game and Fish Commission will be stationed on location during the time of application. Agencies and organization will be consulted prior to application and also be requested to observe the actual operation. Toxicological information on Tordon, Banvel and 2, 4-D Amine and their evaluation of safety to the aquatic chaim, fish and birds has been completely researched and studied and by following the precautionary measures as outlined on the labels no adverse conditions will exist. The chemicals listed are classified as relatively non-toxic to fish and wildlife when used in compliance with the recommended rates and pesticide labels.

TOXICOLOGY OF PICLORAM AND SAFETY EVALUATION of TORDON HERBICIDES

Use of the herbicide 4-amino-3,5,6-trichloropicolinic acid (picloram) presents no problem regarding safety to humans, livestock, or wildlife. The acute oral toxicity is low in both small and large animals, with LD_{50} values of 2000 and 8000 mg/kg in rabbits and rats, respectively. No adverse effect was observed in rats fed diets containing 1000 ppm for 90 days, and only minimal effects were produced at 10,000 ppm (1% of the total diet). A no-effect level of at least 150 mg/kg/day was obtained in 2-year feeding studies in rats and dogs. Its toxicity is also very low for birds, fishes, and other aquatic organisms. Treatment of rangeland or of fields of small grain with effective dosages of TORDON herbicides would not produce toxic residues in feeds for animals nor in foods to be consumed by humans.

Toxicological information shown on attached sheet B.

11. Insects and Disease: No insect or disease problems are expected as a result of this project.

12. Land Use: This project is in a area where multiple use concept prevails.

13. Historical and Archeological: There are known historical and archeological sites within the program area. These sites will not be disturbed. Monitoring of sites will be conducted in cooperation with the Wyoming Recreation Commission and the State Archeologist.

For verification see Attached letter.

14. Minerals: Because of its geological setting in the rich Powder River Basin resource area, there is present mineral activity and potential for future mineral development is anticipated.

15. Economics: The estimated cost of this project during the five year period is approximately $1,803,114.00.

Land values will increase, and in addition, this project will provide for excellent land management through improvement of vegetative cover, soil, water resource, and limit spread to many more acres creating a cost-return ratio of astronomical proportions. Postponing this project would cause an even greater economical loss to Wyoming and neighboring states. Each year costs and the spread of infestations of Leafy Spurge would be overwhelming. For additional information on economics, refer to the attached proposal for pilot project and report to The Old West Regional Commission.

16. Effects of Operation: Noise pollution from the project would be minimum, temporary, and will be eliminated as soon as the project is completed. The odor of chemicals, if objectionable will cause no adverse conditions.

17. Monitoring: Of the stream flow for chemical residue in area will

11. Insects and Disease: No insect or disease problems are expected as a result of this project.

12. Land Use: This project is in a area where multiple use concept prevails.

13. Historical and Archeological: There are known historical and archeological sites within the project area. These sites will not be disturbed. Monitoring of sites will be conducted in cooperation with the Wyoming Recreation Commission and the State Archeologist.

For verification see attached letter.

14. Minerals: Because of its geological setting in the rich Powder River Basin resource area, there is present mineral activity and potential for future mineral development is anticipated.

15. Economics: The estimated cost of this project during the five year period is approximately $1,800,000.00.

Land values will increase, and in addition, this project will provide for excellent land management through improvement of vegetative cover, soil, water resource, and limit sprawl to many more acres creating a cost-return ratio of astronomical proportions. Postponing this project would cause an even greater economical loss to Wyoming and neighboring states. Such great costs and the spread of infestations of Leafy Spurge would be overwhelming. For additional information on economics, refer to the attached proposal for this project and report to the Old West Regional Commission.

16. Effects of Operation: Noise pollution from the project would be minimum, temporary, and will be eliminated as soon as the project is completed. The odor of chemicals, if objectionable will cause no adverse conditions.

17. Monitoring: Of the stream flow for chemical residue in area will

be conducted in cooperation with Department of Environmental Quality, Water Quality Division. Area will be monitored during all phases of project including prior and after completion of project.

III. Favorable Environment Effects:The proposed project would contain and eradicate 17,209 acres of Leafy Spurge and be substituted with increased vegetative cover of natural grasses, forbs and shrubs. The eradication of Leafy Spurge will contribute to the elimination of pollution to the environment. Change 17,209 acres of non-utilized land into useable land. Increase the land to its fullest potential and revert it back into the ecological system.

IV. Unavoidable adverse environmental effects : None.

V. Relationship between short-term uses of man's environment and the maintenance of long-term productivity: (Expected from the proposed action) Leafy Spurge being unpalatible to domestic and game animals voids even short-term use. Both rangeland and cropland productivity is negative, so there is not even a short-term use of infested lands. With the need for increased agricultural productivity in the near future the maximum long-term productive capacity of the land must be maintained and/or improved.

VI. Irreversible and irretrievable commitment of resources: None.
This project would leave no permanent impacts or changes on land, other than return it near to its productive potential other than already shown in this report.

VII. Alternatives to the proposed action: (Their important impacts/effects and reasons for non-selection). There are no known alternatives, other than those mentioned in the attached report.

VIII. Consultation with Others: (Especially, Out-Service) Various agencies and/or organizations have been consulted concerning this project. They have

inspected the proposed project and foresee no serious impact. Most organization favor this project. A series of informal meetings have been held and more future meetings are proposed. These organizations represent most social and economic interests in the area. If required a "show me" trip will be sponsored. One such trip was conducted in July of 1974.

Agencies and Organization consulted are as follows:

1. U.S. Bureau of Land Management
2. State Department of Public Lands.
3. Wyoming Game and Fish.
4. University of Wyoming.
5. Wyoming Weed & Pest Council.
6. Wyoming Board of Agriculture.
7. Wyoming Stockgrowers Association.
8. Wyoming Association of Conservation Districts
9. Wyoming Department of Environmental Quality.
10. Wyoming Recreation Commission.
    a. Division of Historical and Archeological.
11. Dow Chemical Company.
12. Governor's Office of State of Wyoming

IX. Management Requirements and Constraints: (To guide administrative actions, contract stipulations, also include a recommendation concerning an EIS). The Wyoming Department of Agriculture will carefully supervise the pilot project in cooperation with various agencies. A time will be selected when climatic conditions are ideal. Project supervisors will be on site at all times during operation of program.

The treatment program will be conducted from approximately April through October for a five year period. Monitoring and evaluation will be tabulated as the program progresses.

This project will be in compliance with state and federal laws.

No major or long-term adverse environmental impacts are expected as a result of this project.

Additional precautionary measures above and beyond the precautions on the pesticide labels will be undertaken, and are as outlined:

1. Areas will be posted prior to start of application.
2. Livestock will be removed from the treatment area prior to application.
3. Reentry period for livestock will be fourteen days after application.
4. Milk producing dairy animals will be kept out of the treated area.

All persons reached through the public involvement effort in connection with this project recognize the seriousness of the Leafy Spurge problem and the value of this improvement in a multiple use concept and favor its implementation.

No major objection to the planned project has been received and none is anticipated. The proposal should not be highly controversial, and there is nothing in the way of impacts that is of major significance. Therefore, an Environmental Impact Statement is not being filed.

X ADDITIONAL INFORMATION ON CHEMICALS

1. Tordon 22K is registered with a state label for use in rangelands and permanent grass pastures in the State of Wyoming only. EPA registration number is 464-323-A.A. Label has clearance for up to 2 lb./acre to control leafy spurge. This represents a concentration of 0.57 ppm/Ac. of active ingredient of picloram acid. (For additional information refer to attached reports).

2. 2,4-D at rate of 2 lbs. active ingredient per acre and/or Banvel at the rate of 1 lb. active ingredient per acre plus clean cultivation on 200 acres. Two or three chemical treatments per year are required on cultivated land. (For additional information refer to attached reports).

3. Banvel at rate of 1 lb./Ac. represents a concentration of 0.299 ppm/Ac of active ingredient. Banvel has EPA clearance for up to 8 lb./ac. on rangeland which represents a concentration of 2.392 ppm/Ac. of active ingredient.

4. 2,4-D at rate of 2 lb./Ac. represents concentration of 0.57 ppm/ac. of active ingredient.

APPENDIX

A. Maps

1. Program Area
2. Land Status
3. Natural Vegetation
4. Soil Types and Capabilities

B. Toxicity Chart

C. 1. Fate of Herbicides
2. Translocation of Herbicides

D. Labels and Precaution measures

1. Tordon 22K
2. 2, 4-D Formula 40
3. Tordon Beads
4. Banvel

E. Slides of Leafy Spurge and benefits, received through control methods.

F. Verification Letters

1. Historical and Archeological
2. Monitoring water - U.S.G.S - W.D.A.

3. Dr Harold Alley

G. 1. Pilot Project
2. Report

LITERATURE AND PESTICIDE LABELS SITED IN REPORT:

1. Tordon Herbicide Information

Tordon - Beads.....(86-1174)

Tordon 22K - Specimen Label, Wyoming Label.....(86-1165)

2,4-D Formula 40 - Specimen Label

A review of Toxicological Information on Tordon Herbicides
G.E. Lynn - DTE Spring 1965 - Form 138-176.

Effects of Herbicides on Estaurine Fauna
Philip A. Butler - Bureau of Comm. Fisheries -
Biological Lab. Southern Weed Control
Proc. - 1965

TORDON Herbicides --- Evaluation of Safety to Fish and Birds
E. Kenaga - DTE Vol. 25 No. - Summer 1969

Toxicology of Picloram and Safety Evaluation of Tordon Herbicides
D.D. McCollister - DTE Vol. 25 No. 2 - Fall 1969.

Effect of TORDON Herbicides on Aquatic Chain Organisms
J.L. Hardy - DTE Vol. 22 No. 2 - Fall 1966 Form 138-218

The Effect of TORDON on Microorganisms and Soil Biological Processes
C.A.I. Goring, J.D. Griffith - DTE Spring 1967

Toxicologic Studies on a New Herbicide in Sheep and Cattle
Reprint - American Journal of Veterinary Research
Vol. 27 #118, Pages 821-24

The Toxicity of Some Organic Herbicides to Cattle, Sheep and Chickens
U.S.D.A. - Reprint 106 - J.S. Palmer and R.D. Radeleff

Herbicides (How Poisonous are They?)
Agricultural Extension Service - L.C. Erickson
R.E. Higgins, C.I. Seeley (University of Idaho)

Pesticides in Soil
R.W. Bovey, C.C. Dowler and M.G. Merkle

Picloram: The Effects of its use as a Herbicide on Environmental Quality.
(NRCC No. 13684)

Relative Toxicity of some Industrial Herbicide to Small Animals (Down to Earth, Volume 29, No. 3, Winter, 1973)

Fate of Herbicides (Down to Earth, Volume 29, No. 3, Winter 1973)

A Promising Future for the Control of Perennial Weeds (Down to Earth, Volume 21, No. 1-2, Summer and Fall, 1965)

Control of Leafy Spurge with Tordon Herbicides (Down to Earth, Volume 23, No. 3, Winter, 1967)

WYOMING

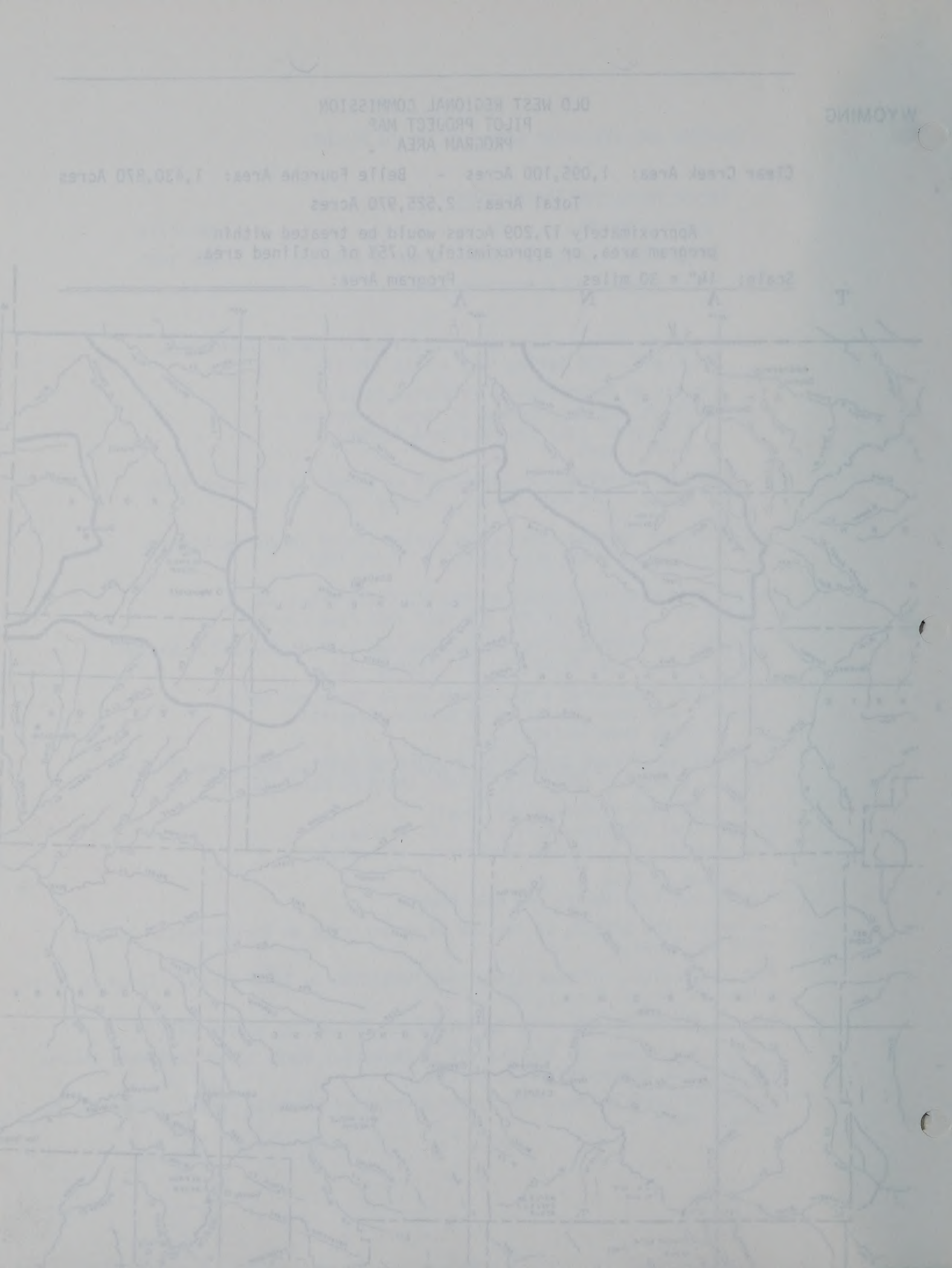
OLD WEST REGIONAL COMMISSION
PILOT PROJECT MAP
PROGRAM AREA

Clear Creek Area: 1,095,100 Acres - Belle Fourche Area: 1,430,870 Acres

Total Area: 2,525,970 Acres

Approximately 17,209 Acres would be treated within program area, or approximately 0.75% of outlined area.

Scale: 1¼" = 30 miles Program Area: _____



Common and Trade Name of Herbicides Mentioned in This Article

Common Name	*Trade Name*
chloramben	Amiben
picloram	Tordon
2,4-D	many
bromoxynil	Buctril
amitrole	Weedazol
paraquat	Paraquat
trifluralin	Treflan
diquat	Diquat
TCA	Sodium TCA
dinoseb	several
monuron	Telvar
diuron	Karmex
fluometuron	Cotoran, Lanex
benefin	Balan
propachlor	Ramrod
propanil	Rogue
EPTC	Eptam
vernolate	Vernam
CDAA	Randox
molinate	Ordram
dichlobenil	Casoron
DCPA	Dacthal
pebulate	Tillam
chlorpropham	Chloro IPC
2,4,5-T	many

attachment C-1

What happens to herbicides in the environment?

By J. B. Weber,
T. J. Monaco,
and A. D. Worsham
North Carolina State Univ.,
Raleigh, N.C.

Reprinted with permission from *Weeds Today* 4(1):16-17,22, 1973.

A few years ago the question of what happens to herbicides after application was of interest mainly to agricultural scientists. But not any more. In today's ecologically-oriented society, there is strong interest in all aspects of pesticide use. In fact, whether the essential agricultural herbicides continue to be legal for use may well depend on educating the public about the ultimate fate of herbicides in the soil, in the air and in water.

Such things as the use of 2,4,5-T in Vietnam, with publicity about possible harmful effects of dioxin (a contaminant present in small amounts), has brought about a general change in attitude about herbicides. Press reports now refer to "biocides," "plant exterminators and annihilators," and "deadly chemical toys" instead of favorable terms like "chemical plows" and "weed killers" that were formerly used. A syndicated newspaper columnist recently referred to several herbicides as "potential baby deformers." Available to counter this bad press is a wealth of research information that explains the fate and behavior of these agricultural chemicals after introduction into the environment. Such information conclusively establishes safety of herbicides use. The critical need is to share these facts with our urban neighbors.

The following discussion of various processes acting on herbicides in the environment points to the complexity of the problem, but it should provide a clearer understanding of what actually takes place. Also obvious is the need for continuing research to ensure future safety as new herbicides become available and new techniques are adapted. Such investigations should tell what happens to the active herbicide applied, accounting for each degradation product remaining, amount lost in the air, and amount present in plants or microbes at the end of the experiment.

Forces That Act on Herbicides

Once herbicides are introduced into the environment, outside forces immediately begin acting on them. Both herbicide degradation processes and herbicide transfer processes play a part in determining the ultimate fate of the chemicals.

Three specific degradation processes serve to break down the herbicides and change their chemical composition:

1. Biological decomposition—degradation by a living organism.
2. Chemical decomposition—breakdown by a chemical process in the absence of a living organism.
3. Photodecomposition—degradation by purely chemical processes involving radiant energy (sunlight).

What happens to herbicides in the environment?

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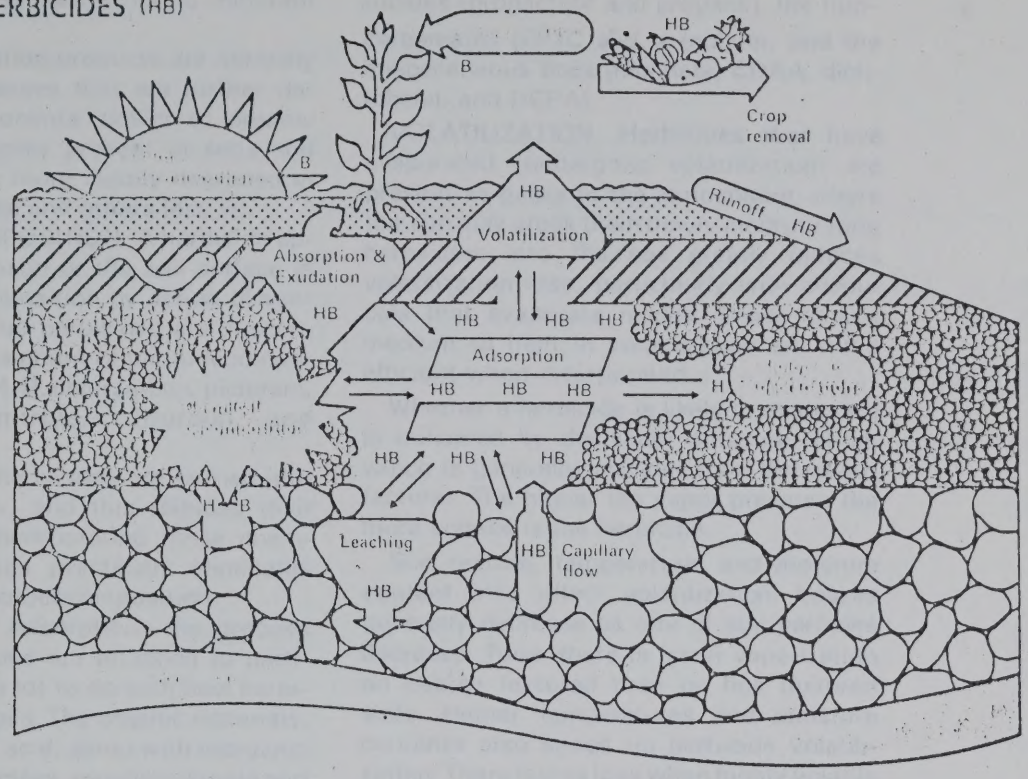
FATE OF HERBICIDES (HB)



Processes influencing the behavior and fate of herbicides in the environment. Degradation processes are characterized by the splitting of the herbicide (HB) molecule. Transfer processes are characterized by the herbicide (HB) molecules remaining intact.

Six transfer processes are important in determining what happens to herbicides in the environment:

1. Absorption and exudation by plants and animals—herbicides can either penetrate through tissues into an organism (absorption) or be discharged from inside an organism to the surrounding environment (exudation).
2. Retention in vegetation and then transference in the harvested product.
3. Adsorption by soil particles, a process by which herbicides transfer from solution or vapor to a solid surface (soil particle).
4. Movement through the air and into the atmosphere. This is the result of volatilization, by which the herbicide is changed from the solid or liquid state into a gas or vapor form.
5. Surface runoff of herbicides into ponds, rivers, and oceans. The herbicide may be either dissolved or suspended in water or be adsorbed to eroding soil particles from treated areas.
6. Movement through the soil, either laterally, as liquid or gas, or vertically (downward by capillary flow).

Degradation Processes

BIOLOGICAL DECOMPOSITION. Biological decomposition of herbicides includes detoxification by plants and soil microorganisms. This breakdown process involves several mechanisms.

Herbicides may be absorbed by plants and microorganisms and stored or given off in their original form. Usually they are changed, however, and the breakdown products are either used by the organism or plant or discharged back into soil solution. In some cases, herbicides are retained within the tissues of the plant or organism, thereby delaying decomposition.

Herbicides may be removed from treated fields if the compounds are present in harvested plant parts, but amounts removed are nearly always insignificant. For example, 1 p.p.m. (part per million) of a herbicide in a 10-ton hay crop amounts to only 0.02 lb. per acre removed in the hay. However, sizable amounts can be degraded by plants during a cropping season.

CHEMICAL DECOMPOSITION. Several processes account for chemical decomposition of herbicides:

1. Oxidation is a degradation reaction in which a compound loses electrons, as in the case of 2,4-D oxidation.
2. Reduction is an opposite reaction in which a compound gains electrons. As in the case of oxidation, this changes the compound from its original form and makes it less stable.
3. Hydrolysis is a degradation process by

which addition of water forms different compounds.

The decomposition products are normally non-toxic substances that are further degraded to components similar to organic molecules commonly present in soils and plants. Some are more readily degraded in the adsorbed state and others less so.

PHOTODECOMPOSITION. A herbicide applied to plant foliage or the soil surface is subject to decomposition by action of sunlight. Most organic herbicides are susceptible to a certain amount of photodecomposition, such as 2,4-D, chloramben, picloram, bromoxynil, amitrole, trifluralin, and paraquat.

Water soluble herbicides are carried into soil by rainwater, and this reduces their decomposition. Incorporating these chemicals into the soil practically eliminates breakdown by photodecomposition.

ADSORPTION. Adsorption—the process by which herbicides are attached to particles of soil—has a lot to do with how herbicides behave in soils. The organic materials, humus and humic acid, along with inorganic materials like the clays, montmorillonite and vermiculite, and the hydrous oxides of iron and aluminum are soil particulate matter responsible for adsorption and inactivation of herbicides.

The adsorption process greatly affects absorption rate of chemicals by plants and other organisms. Thus, it helps determine herbicide performance. Changing of a herbicide from solid or liquid to a gas is affected by attachment of the chemical to soil particles. Adsorption also has a lot to do with how chemicals move in liquid—downward leaching or upward movement by capillary action.

Several processes explain how herbicides are retained by soil colloids through adsorption. Positively charged (cationic) herbicides like diquat and paraquat are strongly held to soil by ionic bonds, much like potassium and calcium are held. Negatively charged anionic herbicides—2,4-D, chloramben, picloram, TCA, dinoseb, and bromoxynil—are not readily adsorbed because they have the same negative charges as the soil particles. However, small amounts may be bound to positively charged soil colloids like iron and aluminum hydrous oxides.

Small amounts of neutral or noncharged (molecular form) herbicides may be retained at the soil surfaces through weak physical forces. Certain non-ionic herbicides are adsorbed to soil particulate matter through relatively weak physical forces. These include the phenylureas (monuron, diuron, and fluometuron), the substituted anilines (trifluralin and benefin), the substituted anilides (propachlor and propanil), the thiocarbamates (EPTC and vernolate), and the miscellaneous ones (molinate, CDAA, dichlobenil, and DCPA).

VOLATILIZATION. Herbicides that have evaporated (undergone volatilization) are present as gases in the atmosphere, where the sun may break them down. Incorporating herbicides into the soil greatly reduces volatilization loss, particularly with chemicals that evaporate readily. Those ranked medium to high in volatilization are more efficient when incorporated.

Whether a herbicide is likely to evaporate is indicated by the vapor pressure rating, which is generally available from the manufacturer. The higher the vapor pressure the more volatile is the herbicide.

Soil texture, temperature, and moisture content also affect volatilization. Losses generally decrease as size of soil particles decrease. Thus, there is faster vaporization on coarse textured than on fine textured soils. Higher temperatures and moisture contents also speed up herbicide volatilization. There is less loss when highly volatile herbicides are applied to cool, relatively dry soils.

Trifluralin, dichlobenil, and chlorpropham are rated "somewhat volatile;" "highly volatile" is the classification for CDAA, EPTC, vernolate, and pebulate.

HERBICIDE RUNOFF. Herbicides applied to the soil surface may dissolve in rainwater and be leached into the soil. Or heavy rains may carry them away from treated areas. Severe runoff can also carry soil particles with adsorbed herbicides off with eroding soil and water. "Washoff" is the term used to describe such losses.

All Processes Associated

All processes involved in herbicide degradation are intimately associated. Adsorption, which directly influences all others, is probably the key process.

The transfer processes are usually reversible and in dynamic equilibrium with the system. Cationic herbicides like diquat and paraquat are exceptions since they are irreversibly adsorbed between sheets of certain clay minerals. Their molecules are held so tightly that they are neither degraded nor released from the soil particles. All other herbicides are in a reversible equilibrium state and are subject to breaking down in soil systems.

Except for gross misapplication and overuse, the degradation processes described will break herbicides down into safe or nontoxic compounds. *There is no evidence of potential build-up or persistence in the soil to contaminate the environment.*

B. Toxicological data: Toxicity charts. (All information can be verified and all data proven)

1. Toxicological data on Tordon 22K and Tordon Beads.

TOXICITY OF TORDON 22K HERBICIDE FORMULATIONS TO FISH

Prepared by George F. Hittle, Wyoming Department of Agriculture

Fish	Formulation	Parts per Million in water	
		Median tolerance limit (a)	Maximum safe limit (b)
Fathead minnow	TORDON 22K	135	100
Brook trout	TORDON 22K	420	320
Rainbow trout	TORDON 22K	230	100
Brown trout	TORDON 22K	240	100
Green trout	TORDON 22K	420	180
Black bullhead	TORDON 22K	420	320

(a) the concentration at which one-half the fish were killed

(b) the maximum concentration tested which caused no observable ill effect in 96 hours exposure.

NOTE: Tordon 22K will be applied at the rate of approximately 350 times less than the maximum safe limit.

RESULTS AND DISCUSSION

Fish

The acute toxicities to various species of fish are shown in the tables. The most accurate comparison of fish toxicity tests, resulting from various

formulations and derivatives, is possible where the test method and species of fish are the same. LC_{50} results using the USDI test method and rainbow trout at 60^{o} F. are shown in table. From the data in tables acid, salts and esters, and their formulations are generally relatively low in fish toxicity (LC_{50} = 1.0 ppm).

Calculations on a theoretical basis assuming that all of the material were to be completely dissolved and evenly distributed indicate that the application of 3 lb. of 4-amino-3,5,6-trichloropicolinic acid directly to pure water three inches deep on an acre of land could result in a maximum concentration of 4.5 ppm in the water. This is considerably less than the LC_{50} values of the potassium, triisopropanolamine and triethylamine salts. The isooctyl ester of the acid is more toxic, the LC_{50} for the most sensitive species being in the order of 1 ppm. Since Tordon herbicides are not recommended for aquatic uses but only for terrestrial applications at a maximum of 3 lb. ae/A, it would be very unlikely that a concentration as high as 1 ppm would reach water by accident or by runoff from such treated areas because of dilution, sorption, degradation, etc. Formulations which also contain 2,4-D or 2,4,5-T are more toxic to fish than formulations which do not.

Among the 15 species of fish tested, none seemed particularly susceptible to the formulations used. In a 90 day exposure test, 5-8 ppm 4-amino-3,5,6-trichloropicolinic acid appeared to have some effect on bluegill populations cause 30% kill and some loss of weight in survivors. The potassium salt maintained at a concentration of 1 ppm ae had no effect on guppy or Daphnia reproduction over a period of six months and no toxicity to goldfish in a 10-week exposure. The potassium salt, at 1 ppm, acid equivalent, did not accumulate in tissues of the aquatic invertebrate, Daphnia, over a 10-week period.

TABLE X. Toxicity to game birds - dietary studies

Species	acid equivalent	observations	reference
Mallard Ducklings	500-10,000	0% mortality	20
Mallard Ducklings	385,260	LC_{50}	22
Japanese Quail	100	14 day exposure, reproduction study. effect on plumage, feathering, egg production, fertility and hatchability, mortality and weight.	21
Japanese Quail (5-7 day old chicks)	100; 500; 1000	Reproductive, 3-generation study. No F-0 generation fed 20 weeks; F-1 generation fed 12 weeks; F-2 generation fed 8 weeks. No statistically significant difference between controls and treatments as measured by food consumption, egg production, fertility and hatchability, survival and body weight gain. No adverse symptoms noted when medicated diets were withdrawn.	19
Japanese Quail	100-10,000	Dosage increased over a period of nearly one year, no increased mortality; decreased consumption or body weight; no impaired reproductive affect compared to controls.	12

Bobwhite quail (5-7 day old chicks)	10,000	LC_{50}	24
Bobwhite quail (5-7 day old chicks)	17,075	LC_{50}	24
Bobwhite quail (5-7 day old chicks)	10,928	LC_{50}	24

Birds

The acute oral LD_{50} to the chicken is very low-approximately 6000 mg/kg[17]. Dietary studies of effects on game birds are shown in Table X. The five-day feeding, eight-day mortality data show that this herbicide (acid, isooctyl ester or triethylamine salt) is very low in toxicity via these test methods, the LC_{50} being between 10,000 and 385,260 ppm for mallards and bobwhite quail[20,22,23,24].

A two-week dietary study on adult Japanese quail, fed 100 ppm ae in the total diety, showed no effect on plumage, feathering, egg production, fertility and hatchability, mortality and weight. At 1000 ppm in a similar test, egg fertility and hatchability were reduced the first week and not the second week of treatment[21]. A three generation study with Japanese quail using dietary treatments of 100,500 and 1000 ppm ae showed no effect on food consumption, egg production, hatchability and fertility, survival and body weight. No adverse symptoms were noted when medicated diets were withdrawn [19]. Japanese quail had a lower mortality rate than the controls when levels in their diets were increased from 100 ppm to 10,000 ppm over a period of nearly a year. No effect on reproduction, feeding or body weights was noted [12].

CONCLUSIONS

amino-3,5,6-trichloropicolinic acid and its salts exhibit low acute toxicity to fish, even if applied directly to water at rates up to three pounds of acid equivalent per acre. Use of the ester formulations and the addition of 2,4-D tended to increase the toxicity to fish. The hazard even here would be low due to physical and environmental factors which prevent the maximum amount of applied herbicide from reaching the fish population.

All derivatives of 4-amino-3,5,6-trichloropicolinic acid are very low in acute toxicity to birds. No chronic toxicity problems were observed in dietary tests in birds. No effects on the reproduction of birds or fish were observed. Biological magnification apparently does not occur with the use of TORDON herbicides.

The laboratory studies of the toxicological properties of TORDON herbicides

in fish and birds are useful indicators of what might be encountered in field experience. Field use of salt and ester formulations has not resulted in any known damage to wild fish or bird populations.

It seems clear that if use directions are followed, TORDON herbicides present a low potential hazard, if any, to fish from terrestrial runoff water or direct accidental contamination of water, and no hazard whatsoever to birds.

TOXICOLOGIC STUDIES ON HERBICIDE IN SHEEP AND CATTLE

Summary

A new herbicide, 4-amino-3,5,6-trichloropicolinic acid, was tested for toxicity after oral administration to sheep and cattle. Single oral doses of 720 mg./kg. of the technical material were not toxic to sheep. Single oral doses of 540 mg./kg. were not toxic for cattle.

Conclusions

The new herbicide, 4-amino-3,5,6-trichloropicolinic acid, is less toxic than 2,4-dichlorophenoxyacetic acid since it did not cause any ill effects at a single oral dose of 720 mg./kg. of body weight in sheep, whereas 2,4-dichlorophenoxyacetic acid caused death in sheep at a dose of 535 mg./kg. of body weight.

Since this new herbicide is used at the rate of only 0.5 or 1.0 kg. per acre, and since doses of 540 mg./kg. (88 Gm to a 166 kg. calf) were not toxic, it seems highly unlikely that the herbicide would cause any toxic effect upon animals grazing sprayed pastures.

ACUTE ORAL TOXICITY OF TORDON TO SHEEP AND CATTLE

Species	Tordon Beads 4-amino-3,5,6-trichloropicolinic acid Dose mg/kg[a]	results	Tordon 22K (25% potassium salt of acid) Dose ~~Date~~ of Formulation[b] mg/kg	fl. oz per 60 lb. sheep	cc per 27 kg sheep	results
Sheep	260	no ill effect	1860	1.5	45	no ill effect
	390	" "	2790	2.2	67	no ill effect
	650	" "	3720	3	89	no ill effect
	___		4650	3.7	110	no ill effect
	mg/kg	results	mg/kg	fl. oz per 400 lb calf	cc per 182 kg calf	results
Cattle	130	no ill effect	2320	12.7	375	no ill effect
	195	no ill effect	3480	19	562	no ill effect
	325	no ill effect				
	488	no ill effect				

(a) milligrams per kilogram of body weight

(b) Dose of formulations expressed as equivalents in three different ways: for example, 1860 mg of Tordon 22K per kg of body weight is equivalent to 1.5 oz. of Tordon 22K per 60 lb sheep which is equivalent to 45 cc of Tordon 22k per 27 kg sheep.

(c) TIPA = Triisopropanolamine

(d) Toxic signs = extreme weakness, depression, incoordination, loss of appetite and abdominal pain. At necropsy sheep showed extensive hemorrhage of abomasum and small intestine.

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TOXICITY RESPONSE OF SMALL ANIMALS OF INDICATED HERBICIDE DOSAGES

Common Name or Designation	Some Common Trade Names	LD-50 mg./kg.	Ingested toxicity rating*	Dermal Response Rating	Mfg. Company ***
Aspirin	(for comparison)	750	4	-----	
Dicamba	Banvel D	1,040	4	4	Velsicol
Picloram	Tordon	8,200	5	4	Dow
Table Salt(NaCl)	(for comparison)	3,320	4		
2,4-D	Various brands	500	4	4	

* The toxicity ratings in the table have the following relative meanings when taken internally:

Toxicity Rating	Class Activity	LD 50 mg/kg	Probable lethal dose for 150 lb man
1	Extremely toxic	less than 5	A taste (less than 7 drops)
2	Very toxic	5 to 49	7 drops to 1 teaspoonful
3	Moderately toxic	50 to 499	1 teaspoon to 1 ounce
4	Slightly toxic	500 to 4,999	1 ounce to 1 pint(1 pound)
5	Almost nontoxic	5,000 to 14,999	1 pint to one quart
6	Nontoxic	15,000 and above	more than 1 quart

** Dermal response ratings have the following relative meanings:

1. Absorbed and poisonous
2. Causes burns and blisters
3. Moderately irritating
4. Mildly irritating
5. Nonirritating

*** May not be sole or primarily manufacturer(s)

THE EFFECT OF TORDON ON MICROORGANISMS AND SOIL BIOLOGICAL PROCESSES

by C.A.I. Goring, J.D. Griffith, F.C. O'Melia, H.H. Scott, and C.R. Youngston
The Dow Chemical Company

Tordon herbicides (containing formulations of 4-amino-3,5,6-trichloropicolinic acid) are being applied to many soils for the control of a wide variety of broad-leaved annual and perennial weeds as well as woody plants.

A matter of interest is whether this herbicide significantly affects the populations and biological processes of microorganisms in soil. Arnold, Santelmann, and Lynd have reported that concentrations as high as 50 ppm of Tordon

did not reduce the growth of Aspergillus niger. The studies reported in this paper were initiated to determine the effect of Tordon herbicide on (a) the growth of a wide variety of microorganisms, and (b) the numbers of bacteria and fungi, carbon dioxide evolution, and nitrogen transformations in soils.

Discussion and Conclusions

The results obtained in these studies are in general agreement with and extend considerably the observations of Arnold, Santelmann, and Lynd. Even at dosages as high as 1000 ppm ae in soil, Tordon herbicide did not appear to significantly affect carbon dioxide evolution from soils, urea hydrolysis or gross counts of bacteria and fungi in the soil. These results are not surprising in view of the "in vitro" studies conducted with some 46 different soil microorganisms. In these experiments, concentrations as high as 1000 ppm ae did not retard the growth and development of any of the organisms except Thiobacillus thiooxidans and did not affect this organism at 100 ppm.

Furthermore, nitrification of ammonium to nitrite in soil (presumably by Nitrosomonas) while partially inhibited at 1000 ppm (acid equivalent) was not inhibited at 100 ppm, and nitrification of nitrite to nitrate in soil (presumably by Nitrobacter) was not significantly inhibited at either 100 or 1000 ppm ae of the herbicide. These autotrophic bacteria are generally considered to be among the more sensitive of the microorganisms in soil.

While it is impossible to conclude that the life processes of the microorganisms in soil are not in any way affected even by very high concentrations of Tordon herbicide, it seems fairly certain that if there are effects they must be very subtle for most soil organisms.

Discussion

Estimate of Acceptable Daily Intake for Man

Extensive experimental data have been obtained on the short-term and long term toxicity of picloram in laboratory animals. Biochemical and metabolism studies indicate that the ingested compound is absorbed and eliminated rapidly by large and small animals, and is excreted unchanged in the urine. From this information an estimate of the acceptable daily intake for man is warranted commensurate with procedures for such estimations established by the joint FAO/WHO Expert Committee on Food Additives and by the report of "Evaluation of the Toxicity of Pesticide Residues in Food."

A dietary level equivalent to 150 mg/kg/day caused no significant toxicological effect in life-time feeding studies with the rat, or in 2-year

feeding studies with the dog. Conventionally, it is appropriate to use a 100-fold margin of safety as a factor for animal data when estimating safe levels for consumption by human subjects. Therefore, the estimated acceptable daily intake (ADI) for man is 1.5 mg of picloram per kg of body weight per day.

Safety of Residues in Food or Feed

Ingestion of vegetation treated with Tordon herbicides will not harm livestock. The steers used in the tissue residue study were fed picloram in graduated doses from 200 to 1600 ppm in the total diet daily for up to 8 weeks with no apparent ill-effect. Since this is equivalent to levels of only 2.6 to 23 mg/kg/day, even extremely high residues of the compound in forage would contribute much less than the no-effect level of 150 mg/kg/day demonstrated in chronic toxicity studies conducted for 2 years in dogs and rats.

Ingestion of meat from animals feeding on vegetation treated with Tordon herbicides would result in little, if any, picloram in the diet of human subjects. For example, if cattle or other ruminants grazed continuously on pasture grasses containing 200 to 400 ppm of the compound, and were slaughtered immediately after removal from such pastures, maximum residues might be 3 ppm in kidney, 0.3 ppm in liver, and 0.1 ppm in meat and fat. Although such a situation would be extremely unlikely, the safety of such residues can be evaluated by the following calculations.

On November 17, 1960, the U.S. Department of Agriculture issued the report entitled "High Consumption of Foods." The "ninth decile" is defined as a value that divides the highest 10% of consumers from the other 90%. The estimated ninth decile is from 1.5 to 3.5 times the mean for consumption of broad groups of foods in the United States.

Assuming that all of the meat eaten every day by the "ninth decile" consumer would come from animals grazed on pastures treated with Tordon herbicides, ingestion of picloram would be as follows:

Kidney		
20 g/day x 3 ppm	=	0.06 mg
Liver		
20 g/day x 0.3 ppm	=	0.006 mg
Meat (muscle and fat)		
338 g/day x 0.1 ppm	=	0.034 mg
Total		0.100 mg per day

Consumption of as much as 0.1 mg/day, unlikely as it may be, amounts to

only a small fraction of the estimated acceptable daily intake (ADI) for man. For example, a human weighing 132 lbs (60 kg) would have an ADI of 1.5 mg/kg/ x 60 kg = 90 mg/day. Ingestion of the maximum of 0.1 mg/day would be (0.1/90) x 100 = 0.11% of the ADI. When compared to the 150 mg/kg/day no ill effect level demonstrated in laboratory animals, the margin-of-safety is 90,000 to 1.

Treatment of small grains with effective dosages of Tordon herbicides would result in residues of no more than 10 ppm in forage, 1 ppm in straw, and 0.3 ppm in grain of barley, oats and wheat. This would be of no consequence whatsoever in the diet of livestock, as shown above in the discussion of safety to livestock and humans for the much higher residues in forage grasses of pasture and rangelands. No residues whatsoever would be expected to occur in milk or meat from livestock consuming forage, straw or grain of barley, oats and wheat.

If all of the flour and other cereal products (4.84 lb/person/week), as well as all of the bakery products (3.2 lb/person/week), at the ninth-decile level of human consumption were prepared from grain containing a residue of 0.3 ppm picloram, then the human dietary intake would be only 0.17% of the 1.5 mg/kg acceptable daily intake for man.

Compared to the no ill-effect level (150 mg/kg/day) for laboratory animals, the margin of safety for a human weighing 60 kg. is 57,300 to 1.

Conclusions

The use of Tordon herbicides presents no problem regarding safety to humans, livestock or wildlife. Numerous investigations with various formulations in small and large animals, birds, fish and aquatic organisms have demonstrated that picloram is relatively innocuous with no alarming pharmacological or toxicological properties. Metabolic studies in animals have shown that no primary breakdown products accumulate.

The toxicity and hazard of picloram to the above named species are as or lower than, those of any commercial herbicide. Its toxicity is also slight for lower forms of plants such as fungi and algae. Certain higher plants are susceptible to its action, which accounts for its effectiveness as an herbicide. Careful attention to proper techniques, dosage and frequency of application can assure a low incidence of inadvertent injury to non-target plant species.

Tordon herbicide formulations have also been registered in Canada, Australia, New Zealand, Ireland, South Africa, and several countries in Europe and South America, in most cases with much less restriction than currently exists for labels in the USA. A large amount of field data has been collected on the fate and

movement of the herbicide in soil. A formula has been developed to predict degradation rates in different soils and under the various climatic conditions prevailing in the fifty states. Studies are continuing on movement of Tordon herbicide in soil and water, and on degradation of picloram by microorganisms and sunlight.

Ultimately, the benefits of one of the most effective materials for the control of broad-leaved weeds and woody brush are expected to out-weigh risks to sensitive plant species so that expanded use of Tordon herbicides will be permitted in the U.S.A.

HERBICIDES (HOW POISONOUS ARE THEY?)

Introduction

The answer is always a relative one--"Compared to what?"

Most herbicides are relatively non-toxic to man. A few, however, are quite poisonous. All must be handled with utmost care. Note that "caution with"--and "fear of" are not equivalent statements. Almost every imaginable substance can be poisonous and American agriculture uses millions of pounds of herbicides annually. America also produces the purest, highest quality food on earth.

To obtain information on toxicity, the herbicides are tested on various animals; mice, rats, etc. Few have been tested on humans. Therefore, the toxicity ratings given hereafter are the known effects on animals and it is probable that the herbicide will produce similar effects on man. Certain individuals may be allergic to a bland chemical or its carrier whereas other individuals may be resistant to some of the more toxic substances.

It should be mentioned that the LD-50 values (lethal to 50% of the animals tested) are for a single dosage. Repeated treatments over long periods may give different results.

Any herbicide ingested in sufficient quantities can cause ill effects. Some are readily absorbed through the skin, others affect the eyes, and some produce disagreeable results when inhaled.

When using any herbicide always:

1. Read the entire label carefully. Be sure to study and follow the precautions on the label.

2. Avoid spilling the material on your skin or clothing. It is best to wear rubber footwear, long sleeves, rubber gloves and other designated protective clothing. In case of spillage, wash the contacted areas immediately with soap and water.

3. Do not smoke while using chemicals.

4. After using chemicals, change clothes and wash thoroughly. This is especially important if the chemical has been spilled on clothing or skin.

The following table gives the common name and one or more trade names of about 100 herbicides that have extensive to minor usage in this state.

Numerical toxicity rating is based on a modification of the classification of pesticides in the Federal Insecticide, Fungicide, and Rodenticide Act; from "Clinical Toxicology of Commercial Products" by Gleason, M.N., Gosselin, R.E., and Hodge, H.D. Williams and Wilkins Co., Baltimore, Maryland, 1963; from 1966 Pesticide Manual, North Carolina State University; and from data supplied by numerous basic product manufacturers.

Discussion

Before any herbicide can be marketed, its toxicity to animals must be registered with the Department of Health, Education and Welfare, and its usefulness as an herbicide must be established with the U.S. Department of Agriculture. These dual regulations place very strict requirements on the development, federal registration, and labeling of all herbicides. These rigid regulations are undoubtedly responsible, in part, for the extremely low number of known cases of herbicide poisoning.

However, accidents do happen and severe errors have been made. The major difficulties have been:

1. failure to read the label.
2. availability to small children
3. carelessness in handling, leaving containers open, not destroying old containers.

Federal regulations also extend to limiting the quantity of any herbicide that can remain as a residue in any treated crop.

Food inspection for pesticide residues is constantly in progress and some shipments with residues in excess of tolerance have been seized and destroyed. To assure the highest quality of food, inspection and detection services are provided by both Federal personnel and by our ~~Idaho~~ State Department of Agriculture.

The ultimate question is, what influence have herbicides and other pesticides had on public health? Recently Drs. R.C. Teal, M.D., and C.H. Hine, M.D., Ph.D, representing the California Medical Association testified as follows:

1. "There has been no increase in morbidity (proportion of diseased persons)

due to the ingestion of agricultural chemicals."

2. "Surveys show --the total public health has improved by the use of pesticides."

3. "Pesticides constitute only a moderate health hazard."

4. "Accidental ingestion by children and adults is due to careless handling. Therefore, more educational efforts are desirable."

SUMMARY

The purpose of this report is to present a summary and interpretation of the extensive published data now available on picloram for use of those concerned with its environmental evaluation. It may also be of interest to those considering new or expanded uses for this herbicide. Another concern of the subcommittee is to evaluate the effect on the environment if picloram were to be used contrary to registered label directions, and contrary to federal or provincial regulations and restrictions.

Picloram is used in Canada on rights-of-way including utility lines, pipelines, highways and railways. In Western Canada a limited amount is also used mainly as a spot treatment for the control of deep-rooted perennial and biennial broadleaf weeds in permanent grass pastures and rangelands and with restrictions on cropland. Products containing picloram constitute only a small portion of the total herbicide consumption in Canada. However, since picloram is highly phytotoxic to many broadleaf plants and relatively persistent in soil, particularly under dry, cold Canadian conditions, the chemical is potentially capable of damaging a wide spectrum of woody and herbaceous broadleaf species.

The persistence of picloram in soil is evidenced by the fact that certain species of plants have been injured, under certain conditions, as long as five years after an application. The use of picloram may entail a long-term commitment on the part of the user concerning crop rotation for a number of years even after a single application. Cash crops such as tobacco, sugar beets, rape, potatoes, and beans are especially vulnerable when planted in areas previously treated with picloram. Species highly sensitive to picloram include forbs, particularly legumes. If picloram is used, the fundamental long-term changes which may occur in the nature of the plant communities must be acceptable to those who use these lands.

The authors of this document have evaluated the available data which could permit the assessment of the environmental impact inherent in the use of picloram under Canadian conditions. The questions which must be answered in such an assessment include:

(1) To what extent is picloram used in Canada?

While at present the total amount of picloram sold is not high, the registered uses acceptable in Canada under the Pest Control Products Act could allow for increased sales of this compound in some areas of the country.

(2) *Is this relatively presistent compound transported into ecosystems adjacent to the site of application?*

Concern about the use of picloram in a given area arises from the possible damage that may result to adjacent picloram-sensitive crops. Damage to these crops may be caused by spray drift or by surface movement of the chemical under conditions of heavy rainfall onto adjacent crop soil or into irrigation water.

Shortly after application, up to 5% of the herbicide may be carried away in runoff from unusally heavy rain or precipitation. The maximum concentration found in runoff water does not usually exceed 2 parts per million (2 thousandths of a gram per litre - 2 mg/l), when up to 1 pound per acre is applied. This decreases quickly as time goes on and within 10 weeks the picloram which enters lakes or streams in runoff is diluted to levels which cannot be measured.

If a dry period follows the application, some photolytic loss of picloram occurs from direct sunshine. Under conditions of moderate rainfall, incorporation of picloram into the upper soil profile minimizes the hazard of surface runoff and may stabilize the chemical from further movement. Movement of picloram is at a maximum in sandy soils and soils containing little organic matter subjected to heavy precipitation immediately after application.

When this highly phytotoxic and persistent material is applied, one of the major concerns is to protect sensitive broadleaf plants directly adjacent to the sites. Except in those areas immediately surrounding the site of application, widespread contamination of aquatic or terrestrial ecosystems by picloram has not been observed. On the other hand, it must be emphasized that potential for expanded use of picloram exists under the present Pest Control Products Act. Should the use of picloram increase to the point where large, contiguous acreages are treated, particularly at rates higher than 1 to 2 pounds per acre, the potential would exist for more adverse effect on the environment.

Most of the picloram applied is slowly degraded in soil by microorganisms. Any picloram which reaches lakes and streams is dissipated by dilution, photodegradation and to some extent by microbial action. It is theoretically possible that phytotoxic concentrations of picloram could move in runoff water and on soil particles into ponds or rivers if its use is significantly expanded. Therefore, further investigations of what happens to picloram in pond sediments and water under Canadian climatic conditions should be encouraged.

(3) Is picloram magnified in the food chain?

Picloram does not accumulate in aquatic or terrestrial food chains. Thus, animals are exposed to picloram chiefly through ingesting it from contaminated plants while small amounts may be absorbed directly from water.

(4) Does the intake of picloram by terrestrial herbivores and aquatic organisms represent a direct toxicological risk?

The available toxicological studies indicate that with present application patterns, the direct effects of picloram on terrestrial animals should be minimal; the direct effects on aquatic organisms also appear to be low. Aquatic organisms are generally not affected by picloram at levels below 1 part per million in water.

(5) Do other ecological effects need to be considered?

Although the direct toxicological effects on animals are low, this does not rule out risks that may be associated with present or future use patterns.

Utilization of picloram or other similar persistent herbicides must be considered in the light of their long-term impact. For example, when picloram is applied to rangeland and pasture, desirable forage is increased by eliminating or reducing unwanted competing and sometimes poisonous plants. But this also reduces the diversity of plant species which can provide stability in the face of drought and other stresses.

Thus, the question remains: Does the use of herbicides in the management of plant communities intended for feeding domestic animals result in reduced diversification of plants and reduced grazing capacity under drought conditions? To answer this question, studies are needed to evaluate the long-term effects associated with the use of selective broadleaf herbicides on rangelands.

Aquatic plants are the primary food source (and hence energy source) for aquatic animal life. In addition, the viability of assemblages of aquatic organisms depends on subtle interrelations between species, nutrients and habitat. If picloram were to be applied to or allowed to enter aquatic ecosystems to a significant extent, additional studies would be needed to delineate the effect of this phytotoxic material on other vital components of the ecosystem such as phytoplankton and macrophytes.

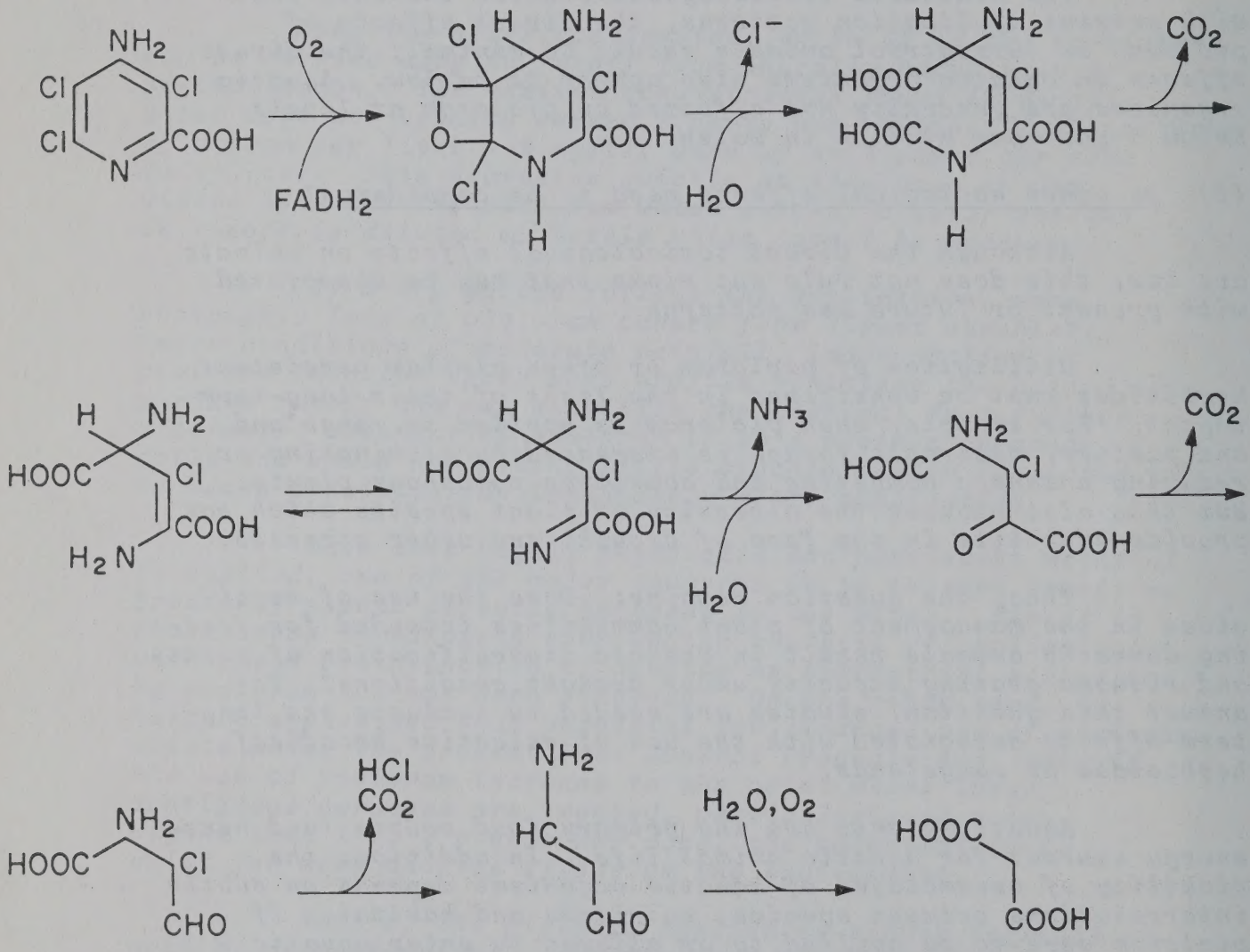
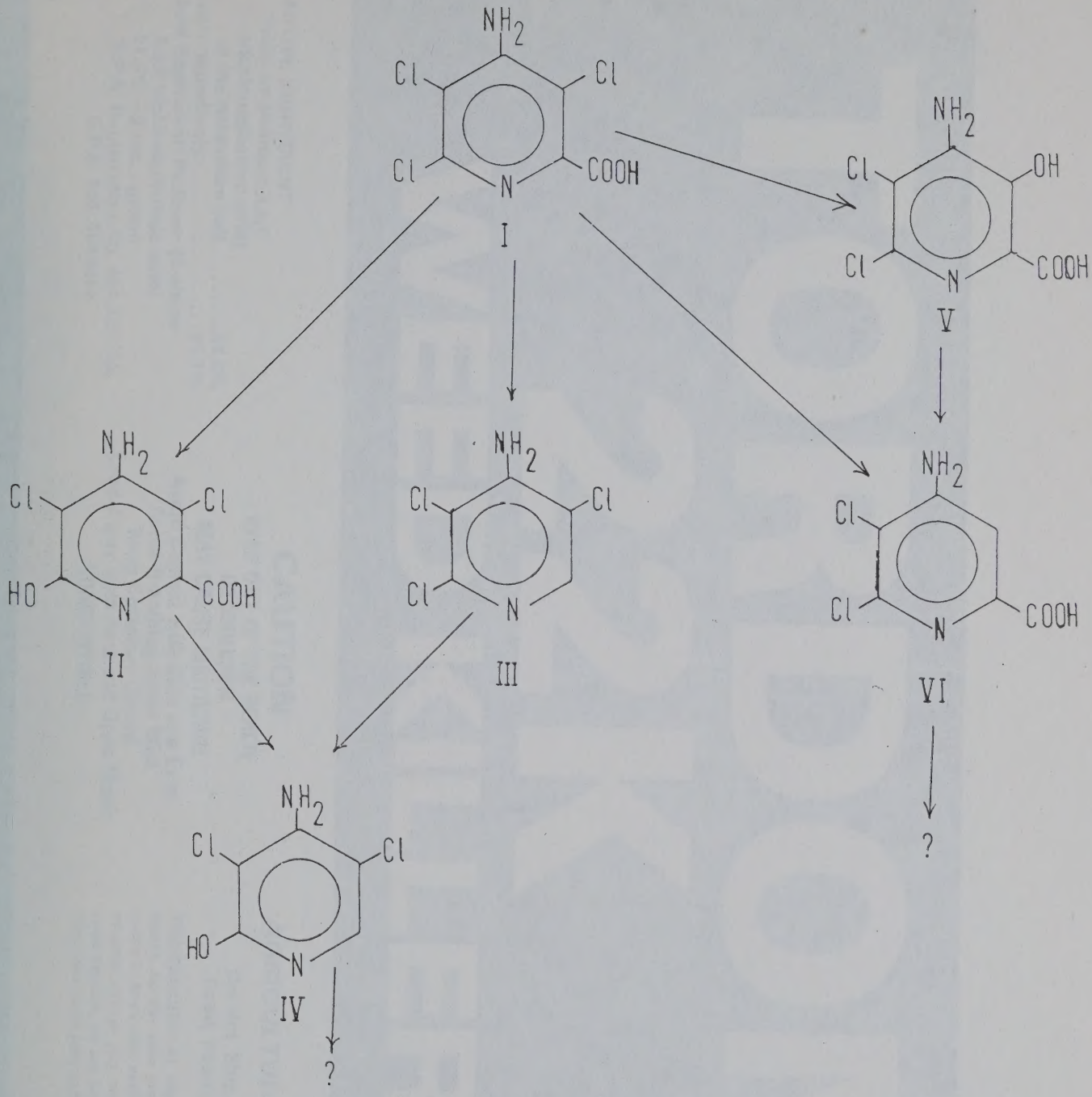
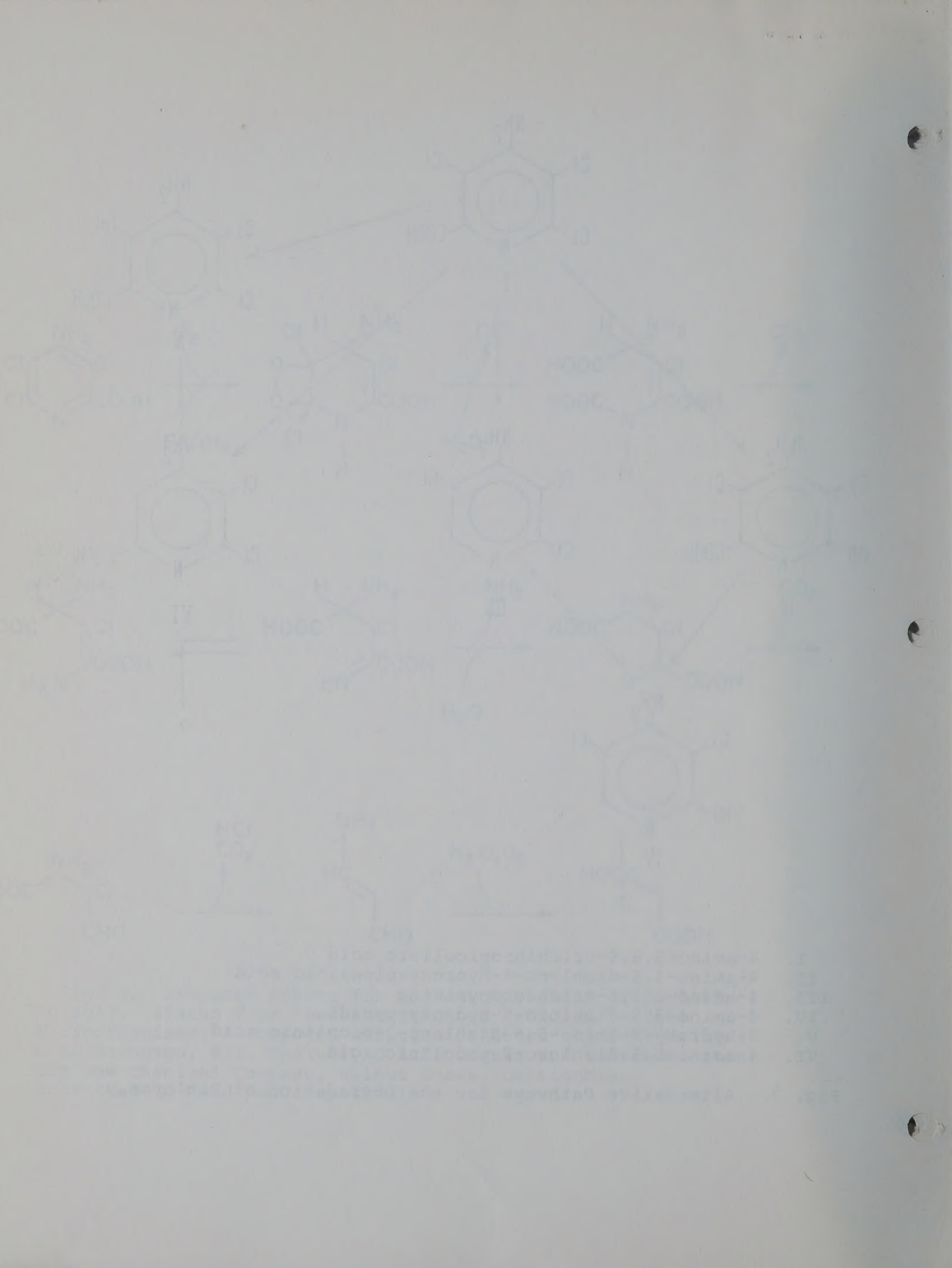


Fig. 4. Proposed scheme for the decomposition of picloram in soil. (Taken from "Decomposition of Picloram by Soil Microorganisms: A Proposed Reaction Sequence" by R.W. Meikle, C.R. Youngson, R.T. Hedlund, C.A.I. Goring and W.W. Addington, The Dow Chemical Company, Walnut Creek, California. Submitted to Weed Sci. May 1973).



I. 4-amino-3,5,6-trichloropicolinic acid
II. 4-amino-3,5-dichloro-6-hydroxy-picolinic acid
III. 4-amino-2,3,5-trichloropyridine
IV. 4-amino-3,5-dichloro-6-hydroxy-pyridine
V. 3-hydroxy-4-amino-5,6-dichloro-2-picolinic acid
VI. 4-amino-5,6-dichloro-2-picolinic acid

Fig. 3. Alternative Pathways for the Degradation of Picloram.



SPECIMEN
REDUCED TO 75%

20

TORDON* 22K WEED KILLER

ACTIVE INGREDIENT
Picloram (4-amino-3,5,6
-trichloropicolinic acid)
as the potassium salt.....24.9%
Inert Ingredients:.....75.1%
Acid Equivalent: Picloram (4-amino
3,5,6-trichloropicolinic acid)
21.5%—2 lbs. / gallon.
E.P.A. Registration No. 464-323-AA
E.P.A. Est. 464-MI-1

CAUTION

KEEP OUT OF THE REACH
OF CHILDREN
MAY CAUSE IRRITATION
Avoid Contact with Skin and Eyes
Avoid Breathing Spray Mist
Keep Container Closed
Keep Away from Heat and Open Flame
COMBUSTIBLE

AGRICULTURAL CHEMICAL

Do Not Ship or Store with
Food, Feeds, or Clothing

PRECAUCION AL USUARIO: Si usted no lee inglés, no use este producto hasta que la etiqueta le haya sido explicada ampliamente.

TRANSLATION: (TO THE USER: If you cannot read English, do not use this product until the label has been fully explained to you.)

18.9 L / 5 GAL

WEEKLY SCHEDULE

Copyright © 2013 Montijo

TORDON® 22K Weed Killer

Active Ingredient:
picloram, (4-amino-3,5,6-trichloropicolinic acid)
as the potassium salt 24.9%
Inert Ingredients: 75.1%
Acid Equivalent:
4-amino-3,5,6-trichloropicolinic acid 21.5%—2 lb/gal.

USE DIRECTIONS

Use TORDON 22K weed killer to control broadleaved perennial weeds such as Canada thistle, field bindweed (wild morningglory), leafy spurge, Russian knapweed and other rangeland weed and brush species such as fringed sagebrush, snakeweed, Geyer (plains) larkspur, rabbitbrush and pricklypear cactus. Treat anytime during the growing season using low pressure (10 to 30 psi) sprays.

Spot Treatment: Use TORDON 22K at rates of 2 to 4 quarts per acre. Use this amount in 20 to 100 gallons of water per acre and apply as a spray to wet foliage. Use the higher rates to control leafy spurge and Russian knapweed. Use the lower rates for field bindweed and Canada thistle. For a 1,000 square foot treatment use 2¼ fluid ounces of TORDON 22K per 1 gallon of water (equivalent to 3 quarts per acre of TORDON 22K).
NOTE: During a single season do not use more than 10 gallons of TORDON 22K for any 100 acre area and do not treat more than 20 acres of any 100 acre area.

Broadcast Treatment: For broadcast treatment a permit for aerial and ground application must be obtained from the Wyoming Department of Agriculture. To control fringed sagebrush, snakeweed, Geyer (plains) larkspur, rabbitbrush, and pricklypear cactus use 1 to 2 pints of TORDON 22K weed killer in 20 to 100 gallons of water per acre with ground equipment or 3 to 5 gallons of water per acre aerially. Apply only as a single broadcast spray during any one growing season.

To control perennial broadleaved weeds such as Canada thistle, leafy spurge and Russian knapweed use 2 to 4 quarts of TORDON 22K weed killer in 20 to 100 gallons of water per acre with ground equipment or 3 to 5 gallons of water per acre aerially and apply only as a single broadcast spray during any one growing season.

For mixture with phenoxy herbicides consult University of Wyoming suggestions on mixtures for specific species.

USE PRECAUTIONS

Do not allow spray drift. TORDON herbicide is highly active. Small amounts may cause damage to plants if applied during either growing or dormant periods. Do not apply or otherwise permit TORDON 22K or sprays containing it to contact desirable plants such as vegetables, flowers, grapes, fruit trees, ornamentals, tomatoes, potatoes, beans of all types, and other valuable broadleaved plants, nor the soil containing roots of nearby valuable plants. Apply TORDON 22K only when there is little or no wind or no hazard from spray drift.

Do not contaminate water. To avoid crop or other plant injury, do not treat or allow spray drift to fall onto inner banks or bottom of irrigation and drainage ditches. Dike around and do not irrigate through treated areas.

Do not move treated soil. Do not go over treated areas with land levelers, cultivation or harvesting equipment, or move the soil by any other means.

Do not transfer livestock directly from areas treated in any one growing season onto broadleaved crop areas without allowing 7 days on untreated grass pastures as urine may contain enough picloram to cause crop injury.

Do not graze treated areas with dairy animals.

Do not treat pastures containing valuable legumes or those intended for harvesting as hay or to be rotated to broadleaved crops.

Do not mix with other pesticides, except phenoxy herbicides in accordance with University of Wyoming suggestions.

Other precautions: Do not store near food, feedstuff, fertilizer, seeds, insecticides, fungicides or other pesticides. To avoid injury to desirable plants, containers and sprayers used for TORDON 22K should not be reused to contain or apply other materials. Be sure that all use of TORDON 22K conforms to local regulations.

Rinse equipment and containers thoroughly with water and dispose of wastes by burying in non-crop land away from water supplies. Containers should be disposed of by punching holes in them and burying with waste.

TORDON® 22K Weed Killer Use Questionnaire

So that we may evaluate how TORDON 22K is being used would you please complete and return this questionnaire.

NAME _____
ADDRESS _____
CITY _____ STATE _____
GALLONS TORDON 22K APPLIED _____
TOTAL SPRAY VOLUME APPLIED _____
DATE APPLIED _____
AREA TREATED (Square Feet) _____
(Acres) _____

NAMES OF WEEDS SPRAYED:
☐ Canada Thistle
☐ Leafy Spurge
☐ Russian Knapweed
☐ Field Bindweed
☐ Others _____
WHO APPLIED: ☐ Self
☐ Custom Applicator, Name _____
☐ Weed Commissioner, Name _____

TYPE OF AREA TREATED
(Check appropriate box(es)):
☐ Flat Terrain
☐ Rolling Terrain
☐ Steep Terrain
☐ Rocky Terrain
☐ Other _____
☐ Clay Soil
☐ Loam Soil
☐ Sand Soil

CAUTION

KEEP OUT OF THE REACH OF CHILDREN
MAY CAUSE IRRITATION—COMBUSTIBLE LIQUID
AVOID CONTACT WITH SKIN AND EYES—
AVOID BREATHING SPRAY MIST—KEEP CONTAINER CLOSED
KEEP AWAY FROM HEAT AND OPEN FLAME

NOTICE: Seller warrants that the product conforms to its chemical description and is reasonably fit for the purposes stated on the label when used in accordance with directions under normal conditions of use, but neither this warranty nor any other warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE, express or implied, extends to the use of this product contrary to label instruction, or under abnormal conditions, or under conditions not reasonably foreseeable to seller, and buyer assumes the risk of any such use.

U. S. Patent No. 3,285,925

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN 48640

THE STATE OF WYOMING

ED HERSCHLER
GOVERNOR

Wyoming Recreation Commission

604 EAST 25TH STREET CHEYENNE, WYOMING 82002

PAUL H. WESTEDT
Director
777-7695

COMMISSION OFFICERS
ALBERT PILCH
PRESIDENT
1800 Morse Lee
Evanston 82930
JACK D. OSMOND,
VICE PRESIDENT
P.O. Box 216
Thayne 83127
DUANE REDMAN
TREASURER
Dubois 82513
MEMBERS
REGNALD BAFFORD
P.O. Box 625
Lusk 82225
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P.O. Box 172
Douglas 82633
LYLE BENTZEN
1001 Pioneer Road
Sheridan 82801
MRS. ROBERT FRISBY
2007 Newton Avenue
Cody 82414
MARVIN HARSHMAN
1507 West Spruce
Rawlins 82301
BILL NATION
2221 Van Lennen Avenue
Cheyenne 82001

June 17, 1975

Mr. Larry Bourret
Acting Commissioner
Division of Plant Industry
Wyoming Department of Agriculture
Cheyenne, WY 82002

Dear Mr. Bourret:

I have received your memorandum of 13 June 1975 in regards to possible historical and archaeological sites disturbance in conducting a pilot project for the containment and eradication of Leafy Spurge in the Old West Region.

Our comments are as follow:

1. Mechanical treatments in fields already under cultivation will not disturb any historic or archaeologic cultural values more than they have already been disturbed.

2. Chemical treatment of infested areas will not affect an historic site except by destroying aesthetic foliage. Obviously the project will guard against such destruction whether or not any historic or prehistoric site is involved.

Therefore, the project is free to proceed insofar as protection of historic values is concerned.

Sincerely,

Paul H. Westedt, Director and
SHPO

Ned Frost

by Ned Frost, Chief
Historic Division

PHW:NF/lml

F-2

Wyoming State Department of Agriculture

and

United States Geological Survey

Modification of Memorandum of Understanding

Pesticide-Herbicide Program

July 26, 1976

The pesticide-herbicide program consists of the following: Sample 20 stations (See Appendix #1) in June or July at high-flow stages and again in September or October as irrigation is discontinued for the season. We will sample both the water and sediment.

The analyses will be performed in the USGS Central Laboratories. The list of pesticides and herbicides is contained in Appendix #2. The cost of the program is approximately $11,232.00. These funds will be made up by discontinuing daily sampling at 13 stations and discontinuing operation of one station (see Appendix #3). Monthly sampling of the stations will continue unchanged. This will make the amount of $11,300 available for collection and analyses of the pesticide-herbicide samples.

If we are to accomplish any additional sampling for Weed Control districts, etc., it is proposed the following estimates of cost be used:

Sampling time - 1 hour
Analysis - $308.35 per sample (sediment & water)
Travel costs (time and other travel expenses)

USGS-WDA Pesticide-Herbicide Program

Appendix #1

List of Pesticide and Herbicide Stations WDA Program

1.	06620000	North Platte River near Northgate, Colo.
x 2.	06------	Seminoe Reservoir at the N. Platte R. inflow.
3.	06------	Glendo Reservoir at the N. Platte R. inflow.
4.	06679500	North Platte River at Mitchell, Nebr.
x 5.	06670500	Laramie River near Fort Laramie, Wyo.
x 6.	06------	Wheatland Reservoir at Laramie River inflow.
7.	06218500	Wind River near Dubois, Wyo.
x 8.	06------	Boysen Reservoir at Wind River inflow.
9.	06259000	Wind River below Boysen Reservoir, Wyo.
x 10.	06277500	Greybull River near Basin, Wyo.
11.	06279500	Bighorn River at Kane, Wyo.
12.	06282000	Shoshone River below Buffalo Bill Reservoir, Wyo.
13.	06286200	Shoshone River at Kane, Wyo.
x 14.	06324500	Powder River near Moorhead, Mont.
x 15.	09209400	Green River near LaBarge, Wyo.
x 16.	09216000	Big Sandy River below Eden, Wyo.
x 17.	09------	Flaming Gorge Reservoir at Blacks Fork inflow.
x 18.	09------	Flaming Gorge Reservoir at Green River inflow.
x 19.	13027500	Salt River near Etna, Wyo.
x 20.	10039500	Bear River at Border, Wyo.

USGS-WDA Pesticide-Herbicide Program

Appendix #2

List of Parameters to be Analyzed

Parameter No.	Name	Analytical Schedule
39516	PCBs	#350
39330	Aldrin	#350
39350	Chlordane	#350
39360	DDD	#350
39365	DDE	#350
39370	DDT	#350
39380	Dieldrin	#350
39390	Endrin	#350
39410	Heptachlor	#350
39420	Heptachlor Epoxide	#350
39340	Lindane	#350
39400	Toxaphene	#350
39570	Diazinon	#354
39398	Ethion	#354
39530	Malathion	#354
39600	Methyl Parathion	#354
39790	Methyl Trithion	#354
39540	Parathion	#354
39786	Trithion	#354
39730	2, 4-D	
39740	2, 4, 5-T	
39760	Silvex	
	2, 4-DP	
	Tordon	

Brave /

USGS-WDA Pesticide-Herbicide Program

Appendix #2--Continued

The analytical procedures for triacine group (atracene, etc.) are in the developmental stage and should be on the line soon. They will be added or substituted to the program at that time.

The bottom sediments will be analyzed for the following:

Parameter No. PCB	Name	Analytical Schedule
39333	Aldrin	#351
39351	Chlordane	#351
39363	DDD	#351
39368	DDE	#351
39373	DDT	#351
39383	Dieldin	#351
39393	Endrin	#351
39413	Heptachlor	#351
39423	Heptachlor Epoxide	#351
39343	Lindane	#351
39403	Toxaphene	#351
39519	Polychlorinated Biphenyls	#351
	Polychlorinated Napthalines	#351

USGS-WDA Pesticide-Herbicide Program

Appendix #3

List of Stations where Daily Sampling is to be Discontinued

06228000 Wind River at Riverton, Wyo.

06235500 Little Wind River at Riverton, Wyo.

06279500 Bighorn River at Kane, Wyo.

06306300 Tongue River at State line

06317000 Powder River at Arvada, Wyo.

06428500 Belle Fourche River at State line

06646600 Deer Creek below Millar Wasteway, at Glenrock, Wyo.

06646800 North Platte River near Glenrock, Wyo.

06670500 Laramie River near Fort Laramie, Wyo.

06674500 North Platte River at Wyoming-Nebraska State line

09209400 Green River near LaBarge

09211200 Green River below Fontenelle Dam

10039500 Bear River at Border, Wyo.

Station to be discontinued

09259700 Little Snake River near Baggs, Wyo.

F-3

THE UNIVERSITY OF WYOMING
PLANT SCIENCE DIVISION
COLLEGE OF AGRICULTURE
AND EXPERIMENT STATION
AGRICULTURAL BUILDING
LARAMIE, WYOMING

MAILING ADDRESS:
UNIVERSITY STATION
P. O. BOX 3354
LARAMIE, WYOMING 82071

WEED CONTROL

April 1, 1976

Mr. George Hittle
Coordinator Weed and Pest
Control
State Dept. of Agric.
Cheyenne, WY 82001

Dear Mr. Hittle:

Leafy spurge (Euphorbia esula), a designated weed in Wyoming, is becoming a serious threat to many thousands of acres of range and cropland in Wyoming. In addition to increasing in acreage of land infested, leafy spurge is the most difficult of the perennial designated weeds to control.

Formulations of picolinic acid, Tordon 22, Tordon-212 or Tordon 2K granules, are the most effective herbicides for the control and eventual elimination of dense stands of this weed species. Other herbicides are available but do not give the percentage reduction in stand that picolinic does and repeated treatments are of a necessity with the other herbicides.

Sincerely,

Harold P. Alley
Professor of Weed Science

HPA:lb

We offer our programs and facilities to all people without regard to race, creed, color, sex, political belief or national origin.

BLM Library
Denver Federal Center
Bldg. 85, OC-521
P.O. Box 25047
Denver, CO 80225

WSO LIBRARY

1. (a) AGENCY - Bureau of Land Management
   (b) PROJECT NO. - 76-WY-06-0001
   (c) TARGET PESTS - Leafy Spurge, Canada Thistle, Musk Thistle, Yellow Toadflax, and Russian Knapweed

2. IMPORTANCE - The target pests are becoming quite common on disturbed BLM and private lands. They continue to spread along and down drainages. They are very competitive with native vegetation and considerably reduce the quantity of usable forage. An action noxious weed inventory and control program has been initiated by a recent contract between the Wyoming Department of Agriculture and BLM.

3. AREA TO BE TREATED - The proposed control area is located in the Clear Creek and Belle Fourche drainage in Sheridan, Johnson, Campbell, Weston and Crook counties of Wyoming, encompassing an area of approximately 1,526,752 total acres. Approximately 18,708 acres will be treated within that total area of which approximately 17,209 acres are permanent grass pasture and rangeland. Of this 17,209 acres, approximately 352 acres are administered by BLM. Vegetation on the rangeland is of various bunchgrasses, needlegrasses, fescues, mixed forbs, sagebrush, conifer and aspen.

4. METHOD - Application will be done with ground spray units and hand-sprayers because of the scattered weed infestations and varying size of the spot areas. Treatment will be conducted by skilled, trained personnel under the supervision of the various County Weed Control District supervisors.

5. SPECIAL PRECAUTIONS - The minimum dosage necessary to control the target pests will be applied. All requirements and restrictions on the label will be followed. Hand spraying will be done on areas close to any sensitive area to avoid any nontarget contamination. All water bodies and live water will be avoided. There are no known endangered plants or animals in the treatment areas.

6. ALTERNATIVE MATERIALS OR METHODS - Nonchemical methods have been first considered, but there are none known that will control the target pests. There are no known effective biological control agents. Other chemicals were also considered, but Picloram is the most persistent and will control the target pests without continued repeated applications.

7. COOPERATORS - The proposed noxious weed control project is a cooperative effort between the Wyoming Department of Agriculture; University of Wyoming; Campbell, Crook, Johnson, Sheridan and Weston County Weed Control Districts; United States Geological Survey and the Bureau of Land Management.

8. MONITORING - Monitoring of the stream flow in the areas for chemical residue will be done in cooperation with the Wyoming Department of Agriculture and United States Geological Survey through their Memorandum of Understanding for the Pesticide-Herbicide Program. The area will be monitored during all phases of the project, including prior to and after completion of the project. Winds will be monitored during application to avoid application above the designated velocities. All precautions will be monitored to assure containment of the chemical to target pest areas.

#15319777625

ID: 88081576

SB
611
.T37
1976

e. Weather - daily; streamflow - prior, during and following treatment by USGS - WDA under their Pesticide - Herbicide Program.

f. EAR completed.

BLM Library
Denver Federal Center
Bldg. 85, OC-521
P.O. Box 25047
Denver, CO 80225

FEDERAL WORKING GROUP ON PEST MANAGEMENT

PEST CONTROL PROGRAM REPORT

DEPARTMENT/AGENCY	DATE SUBMITTED
Bureau of Land Management	August 17, 1976
DIVISION	PERSON TO CONTACT/TELEPHONE NO
Division of Resources	Gail Wielang

Refer to attached instructions before completing form

OBJECTIVE

(1)
a) PROJECT NO
b) SPECIFIC TARGET PEST *(include life stage or stage of growth)*
c) PURPOSE *(if crop protection, what crop?)*

a. 76-WY-06-0001
b. Leafy Spurge, Canada Thistle, Musk Thistle, Yellow Toadflax and Russian Knapweed.
c. Contain and eradicate to prevent range and crop lands from infestation; restore natural vegetation.

PESTICIDE

(2)
a) COMMON NAME
b) FORMULATION
c) % AI, AE, OR LB/GAL
d) REGISTRATION NO *(required)*

a. Torodon 22 K
b. 4 amino - 3, 5, 6 - trichlorophiocolinic acid
c. 2 pounds per gallon
d. EPA 464-323-AA; WY 464-323-1068-76

APPLICATION

(3)
a) FORM APPLIED *(Dust, granule, emulsion, bait, solution, gas, etc.)*
b) USE STRENGTH (%) OR DILUTION RATE
c) DILUENT

a. Solution
b. One gallon in 20 - 150 gallons of water
c. Water

(4)
LBS AI PER ACRE OR OTHER RATE

2 pounds per acre = 0.57 ppm per acre for spot treatment

(5)
a) METHOD *(Aerial, ground, aer.-rad., U.L.V., I.V., other)*
b) EQUIPMENT *(type)*

a. Ground
b. Ground spray units and hand sprayers

(6)
a) ACRES OR OTHER UNIT TO BE TREATED
b) NUMBER OF APPLICATIONS
c) NUMBER OF SITES
d) SPECIFIC DESCRIPTION OF SITES

a. 352 BLM acres in 5 counties
b. Single application first year, repeat on 25% of area 2nd year; 10% 3rd and 4th year; 5% 5th year
c. 38 spot areas
d. Dry rangeland

(7)
a) MONTH(S) OF YEAR
b) STATE(S)

a. April to October
b. Wyoming

SENSITIVE AREAS[1]

(8)
a) AREAS TO BE AVOIDED
b) AREAS TO BE TREATED WITH CAUTION
Specify (a) or (b)

[1] *Croplands, lakes, streams, food, human exposure, endangered species, other*

a. Cropland, lakes, streams or other live water
b. All other areas.

REMARKS

PRECAUTIONS TO BE TAKEN
USE OF TRAINED/CERTIFIED PERSONNEL
STATE AND LOCAL COORDINATION
OTHER PESTICIDES BEING APPLIED TO SAME SITE
MONITORING

a. Chemicals be applied in full compliance with the label. No spraying when wind velocity exceeds 5 mph.
b. County Supervisor's have completed pesticide training under EPA standards.
c. Campbell, Crook, Johnson, Sheridan and Weston County Weed Districts; Wyo. Dept. of Agric.; U.S. Bur. of Reclamation; and BLM.

20 to 100 gallons of water per acre with ground equipment or 3 to 5
ply only as a single broadcast spray during any one growing season.
ılt University of Wyoming suggestions on mixtures for specific species.

SE PRECAUTIONS

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TION

REACH OF CHILDREN
N—COMBUSTIBLE LIQUID
TH SKIN AND EYES—
ST—KEEP CONTAINER CLOSED
EAT AND OPEN FLAME

rms to its chemical description and is reasonably
sed in accordance with directions under normal
or any other warranty of MERCHANTABILITY or
ess or implied, extends to the use of this product
l conditions, or under conditions not reasonably
k of any such use.
No. 3,285,925

• MIDLAND, MICHIGAN 48640

SPECIMEN LABEL

DOW

TORDON® 22K

Weed Killer

For control of certain weed and brush species in rangelands and permanent grass pastures in the state of Wyoming only.

CAUTION
KEEP OUT OF REACH OF CHILDREN
Read Complete Precautions on Rear Panel

THE DOW CHEMICAL COMPANY
MIDLAND, MICHIGAN 48640

SPECIMEN LABEL

DOW

TORDON® 22K

Weed Killer

For control of certain weed and brush species in rangelands and permanent grass pastures in the state of Wyoming only.

CAUTION

KEEP OUT OF REACH OF CHILDREN

Read Complete Precautions on Back Panel

THE DOW CHEMICAL COMPANY

MIDLAND, MICHIGAN 48640

TORDON® 22K Weed Killer

Active Ingredient:
picloram, (4-amino-3,5,6-trichloropicolinic acid)
as the potassium salt 24.9%
Inert Ingredients: 75.1%
Acid Equivalent:
4-amino-3,5,6-trichloropicolinic acid 21.5%—2 lb/gal.

USE DIRECTIONS

Use TORDON 22K weed killer to control broadleaved perennial weeds such as Canada thistle, field bindweed (wild morningglory), leafy spurge, Russian knapweed and other rangeland weed and brush species such as fringed sagebrush, snakeweed, Geyer (plains) larkspur, rabbitbrush and pricklypear cactus. Treat anytime during the growing season using low pressure (10 to 30 psi) sprays.

Spot Treatment: Use TORDON 22K at rates of 2 to 4 quarts per acre. Use this amount in 20 to 100 gallons of water per acre and apply as a spray to wet foliage. Use the higher rates to control leafy spurge and Russian knapweed. Use the lower rates for field bindweed and Canada thistle. For a 1,000 square foot treatment use 2¼ fluid ounces of TORDON 22K per 1 gallon of water (equivalent to 3 quarts per acre of TORDON 22K).
NOTE: During a single season do not use more than 10 gallons of TORDON 22K for any 100 acre area and do not treat more than 20 acres of any 100 acre area.

Broadcast Treatment: For broadcast treatment a permit for aerial and ground application must be obtained from the Wyoming Department of Agriculture. To control fringed sagebrush, snakeweed, Geyer (plains) larkspur, rabbitbrush, and pricklypear cactus use 1 to 2 pints of TORDON 22K weed killer in 20 to 100 gallons of water per acre with ground equipment or 3 to 5 gallons of water per acre aerially. Apply only as a single broadcast spray during any one growing season.

To control perennial broadleaved weeds such as Canada thistle, leafy spurge and Russian knapweed use 2 to 4 quarts of TORDON 22K weed killer in 20 to 100 gall
gallons of water per acre aerially and apply only as a
For mixture with phenoxy herbicides consult University

USE PREC

Do not allow spray drift. TORDON herbicide is highly
applied during either growing or dormant periods. Do
containing it to contact desirable plants such as vegeta
potatoes, beans of all types, and other valuable broa
valuable plants. Apply TORDON 22K only when there

Do not contaminate water. To avoid crop or other plan
banks or bottom of irrigation and drainage ditches. Dik

Do not move treated soil. Do not go over treated area
or move the soil by any other means.

Do not transfer livestock directly from areas treated i
without allowing 7 days on untreated grass pastures as

Do not graze treated areas with dairy animals.

Do not treat pastures containing valuable legumes or
broadleaved crops.

Do not mix with other pesticides, except phenoxy her
gestions.

Other precautions: Do not store near food, feedstuff, fert
To avoid injury to desirable plants, containers and spra
tain or apply other materials. Be sure that all use of TO

Rinse equipment and containers thoroughly with water
from water supplies. Containers should be disposed of

TORDON® 22K Weed Killer Use Questionnaire

So that we may evaluate how TORDON 22K is being used would you please complete and return this questionnaire.

NAME _____
ADDRESS _____
CITY _____ STATE _____
GALLONS TORDON 22K APPLIED _____
TOTAL SPRAY VOLUME APPLIED _____
DATE APPLIED _____
AREA TREATED (Square Feet) _____
(Acres) _____

NAMES OF WEEDS SPRAYED:
- ☐ Canada Thistle
- ☐ Leafy Spurge
- ☐ Russian Knapweed
- ☐ Field Bindweed
- ☐ Others _____

WHO APPLIED: ☐ Self
- ☐ Custom Applicator, Name _____
- ☐ Weed Commissioner, Name _____

TYPE OF AREA TREATED
(Check appropriate box(es)):
- ☐ Flat Terrain
- ☐ Rolling Terrain
- ☐ Steep Terrain
- ☐ Rocky Terrain
- ☐ Other _____
- ☐ Clay Soil
- ☐ Loam Soil
- ☐ Sand Soil

CAUTION

KEEP OUT OF THE REACH
MAY CAUSE IRRITATION—COV
AVOID CONTACT WITH SKI
AVOID BREATHING SPRAY MIST—KE
KEEP AWAY FROM HEAT AN

NOTICE: Seller warrants that the product conforms to its c
fit for the purposes stated on the label when used in acc
conditions of use, but neither this warranty nor any othe
FITNESS FOR A PARTICULAR PURPOSE, express or impli
contrary to label instruction, or under abnormal condition
foreseeable to seller, and buyer assumes the risk of any s

U.S. Patent No. 3,285,

THE DOW CHEMICAL COMPANY • MID

2K Weed Killer

inic acid)

..... 24.9%

..... 75.1%

1.5%–2 lb/gal.

NS

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nd ground application must be obtained from ebrush, snakeweed, Geyer (plains) larkspur. 22K weed killer in 20 to 100 gallons of water re aerially. Apply only as a single broadcast

leafy sp[illegible] and Russian knapweed use 2 to

4 quarts of TORDON 22K weed killer in 20 to 100 gallons of water per acre with ground equipment or 3 to 5 gallons of water per acre aerially and apply only as a single broadcast spray during any one growing season. For mixture with phenoxy herbicides consult University of Wyoming suggestions on mixtures for specific species.

USE PRECAUTIONS

Do not allow spray drift. TORDON herbicide is highly active. Small amounts may cause damage to plants if applied during either growing or dormant periods. Do not apply or otherwise permit TORDON 22K or sprays containing it to contact desirable plants such as vegetables, flowers, grapes, fruit trees, ornamentals, tomatoes, potatoes, beans of all types, and other valuable broadleaved plants, nor the soil containing roots of nearby valuable plants. Apply TORDON 22K only when there is little or no wind or no hazard from spray drift.

Do not contaminate water. To avoid crop or other plant injury, do not treat or allow spray drift to fall onto inner banks or bottom of irrigation and drainage ditches. Dike around and do not irrigate through treated areas.

Do not move treated soil. Do not go over treated areas with land levelers, cultivation or harvesting equipment, or move the soil by any other means.

Do not transfer livestock directly from areas treated in any one growing season onto broadleaved crop areas without allowing 7 days on untreated grass pastures as urine may contain enough picloram to cause crop injury.

Do not graze treated areas with dairy animals.

Do not treat pastures containing valuable legumes or those intended for harvesting as hay or to be rotated to broadleaved crops.

Do not mix with other pesticides, except phenoxy herbicides in accordance with University of Wyoming suggestions.

Other precautions: Do not store near food, feedstuff, fertilizer, seeds, insecticides, fungicides or other pesticides. To avoid injury to desirable plants, containers and sprayers used for TORDON 22K should not be reused to contain or apply other materials. Be sure that all use of TORDON 22K conforms to local regulations.

Rinse equipment and containers thoroughly with water and dispose of wastes by burying in non-crop land away from water supplies. Containers should be disposed of by punching holes in them and burying with waste.

Killer Use Questionnaire

N 22K is being used would you please

_____

_____

_____ STATE _____

_____

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_____

_____

_____

TYPE OF AREA TREATED
(Check appropriate box(es)):

- ☐ Flat Terrain
- ☐ Rolling Terrain
- ☐ Steep Terrain
- ☐ Rocky Terrain
- ☐ Other _____
- ☐ Clay Soil
- ☐ Loam Soil
- ☐ Sand Soil

CAUTION

KEEP OUT OF THE REACH OF CHILDREN
MAY CAUSE IRRITATION—COMBUSTIBLE LIQUID
AVOID CONTACT WITH SKIN AND EYES—
AVOID BREATHING SPRAY MIST—KEEP CONTAINER CLOSED
KEEP AWAY FROM HEAT AND OPEN FLAME

NOTICE: Seller warrants that the product conforms to its chemical description and is reasonably fit for the purposes stated on the label when used in accordance with directions under normal conditions of use, but neither this warranty nor any other warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE, express or implied, extends to the use of this product contrary to label instruction, or under abnormal conditions, or under conditions not reasonably foreseeable to seller, and buyer assumes the risk of any such use.

U. S. Patent No. 3,285,925

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